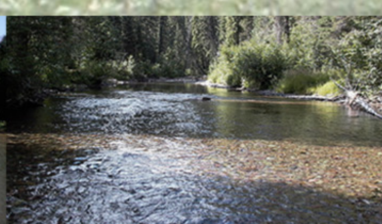
Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area, Montana: Appendix C


December 31, 2004

Flathead Headwaters TMDL Planning Area: Appendix C

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Sampling and Analysis Plan

Sampling and Analysis Plan

As shown in Table 2-1, the 303(d) listed stream segments in the Flathead TMDL Planning are listed as impaired for sediment. The 1996 impairment determination was based on limited data and recent, available data were inconclusive regarding potential sediment related impairments. As a result, a minimum of one site per stream segment was sampled for the following parameters:

- *Physical Habitat Parameters* – Wolman pebble counts, Pfankuch Ratings, channel cross-sections, longitudinal profile (slope)
- *Biological Parameters* – Macroinvertebrates

The sample sites are listed in Table 3-1 and shown in Figure 3-1. When possible, sampling sites were located at historical Forest Service sites with existing Pfankuch information. For streams lacking historical Pfankuch data, the sampling site was located at the mouth of the drainage. Sites were located in Rosgen C Channel types with the expectation that these channel types are most responsive to upstream impacts.

Forest Service protocols (Harrelson, 1994) were followed for the physical habitat measurements. The stream reach for the assessment was established at ten times the stream width upstream from the midpoint and ten times the stream width downstream from the midpoint. Additional detail on establishing a reach is provided in the *Stream Channel Reference Sites: An Illustrated Guide to Field Technique* (Harrelson, 1994). Physical surveys include channel cross-section measurements, Pfankuch ratings, and Wolman pebble counts.

The Pfankuch Stream Channel Stability rating (Pfankuch, 1978) uses a qualitative visual measurement with associated mathematical values to reflect stream conditions. The rating is based on 15 catgeories: six related to the bottom of the stream channel (the part of the channel covered by water yearlong), five related to the lower banks (covered by water only during spring runoff), and four related to the upper banks (covered by water only during flood stages). Acceptable Pfrankuch ratings have been refined based on their Rosgen stream classification (Rosgen 1996).

Wolman pebble counts involved walking a transect in a riffle section from bankfull to bankfull width. The field person placed one foot in front of the other and, without looking down, selected a rock and measured the intermediate diameter of the rock. This information was recorded and the procedure followed until a minimum of 100 rocks per transect were counted (Wolman, 1954).

Pfankuch ratings and Wolman pebble counts were completed at three sites in the stream reach (upper limit, midpoint, and the lower limit). Channel cross-section measurements were completed only at the midpoint. Elevation data was gathered every five feet in the center of the bankfull width. This data was used to generate a longitudinal profile for each stream.

EPA and FNFS staff collected macroinvertebrate samples in August 2003. Field staff kicked and scrubbed a square meter area of the stream bottom substrate until 300 organisms were collected in a D-frame net (1 mm mesh size). These protocols followed methods established by MT DEQ (MT DEQ, 2003).

Table 1. **Sample designations and locations.** Sites are listed by drainage in upstream-to-downstream order. North, Middle, and South Forks of the Flathead River drainage, August 2002 and August and September 2003.

Site	Location	Description	Sampling Date	Latitude/ Longitude	Parameters				
					CS	Pf	LP	W	M
North Fork of the Flathead River									
Whale Creek	Whale Creek #2	800 ft. above FS Rd #1672	07-17-03	48.85996/114.55266	X	X	X	X	
	Whale Creek Upstream Site	Above FS Rd #1672	08-27-03	48.85988/114.54779					X
	Whale Creek	At North Fork Bridge	08-27-03	48.85146/114.36242					X
	Whale Creek #1	2000 ft. above Moose Creek Rd (#1671)	07-14-03	48.863.43/114.46546	X	X	X	X	
Red Meadow	Red Meadow Creek	At North Fork Road	08-27-03	48.80707/114.34727					X
	Red Meadow Creek	Approx. 3 miles u.s. of FS Rd #115	07-08-03	48.80874/114.43084	X	X	X	X	
	South Fork Red Meadow	1000 ft. u.s. of North Fork Road	07-10-03	48.80430/114.34601	X	X	X	X	
North Fork Coal Creek	North Fork Coal Creek	Above Bridge on FS Rd #317 to S Fork	08-27-03	48.69178/114.37678					X
	North Fork Coal Creek #1	1 mile along FS Rd #317b	10-01-03	48.70605/ 114.45939	X	X	X	X	
	North Fork Coal Creek #2	Approx. 4 miles along FS Rd #317b	10-07-03	48.69165/114.39179	X	X	X	X	
South Fork Coal Creek	South Fork Coal Creek #1	Above Bridge on FS Rd #317	08-27-03 (macro) / 09-15-03	48.67474/114.40942	X	X	X	X	X
	South Fork Coal Creek#2	Upstream of FS boundary w/ state lands	09-23-03	48.68306/114.36524	X	X	X	X	

Site	Location	Description	Sampling Date	Latitude/ Longitude	Parameters CS	Pf	LP	W	M
Coal Creek	Coal Creek	At Deadhorse Bridge	08-27-03						X
	Coal Creek #1*	2000' Above Deadhorse Bridge	10-07-03	48.67383/114.32448	X	X	X	X	
	Coal Creek	At North Fork Road	08-27-03	48.68819/114.19916					X
	Coal Creek #2	Approx. 1000' above Rd #317	10-15-03	48.66157/114.24334	X	X	X	X	
Middle Fork of the Flathead River									
Morrison Creek	Morrison Creek	1 mile past Trail #154 on Rd #569	07-15-03 /08-26-03 (macro)	48.21572/113.29020	X	X	X	X	X
Challenge Creek	Challenge Creek	Near Campground	08-26-03	48.23018/113.33150					X
Granite Creek	Granite Creek	100 ft d.s. of Tumbler Crk confluence	09-10-03	48.22313/113.33156					X
	Granite Creek	100 ft d.s. Challenge/Dodge Confluence	07-16-03	48.22660/113.33263	X	X	X	X	
Skyland Creek	Skyland Creek	Above confluence with Bear Creek	08-23-02	48.2929 / 113.3890				X	X
South Fork of the Flathead River									
Sullivan Creek	Sullivan Creek	Above confluence with Conner Creek	08-22-02	47.9756 / 113.6687	X	X		X	X
	Sullivan Creek	Below Quintonkian	08-22-02	48.0278 / 113.7052	X	X		X	X

Biological Reports

Three biological reports on the Sullivan and Skyland Creek and the Flathead River drainage are included in this section.

A Biological Assessment of Sites on Sullivan and Skyland Creeks: Flathead County, Montana Project TMDL-C08

August 2002

A report to

The Montana Department of Environmental Quality
Helena, Montana

by

Wease Bollman
Rhithron Associates, Inc.
Missoula, Montana

May 2003

INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected in August 2002 from two sites on Sullivan Creek and one site on Skyland Creek in Flathead County, Montana. These study sites lie within the Canadian Rockies ecoregion (Woods et al. 1999).

A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is “…a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region’s natural environment…” (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as “… an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition.” (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1996). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998a). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied enhances the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat measures and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998a) has recently studied the assemblages of the Montana Valleys and Foothill Prairies ecoregion, and has recommended a battery of metrics applicable to the montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to measures of habitat integrity, and consistent over replicated samples.

METHODS

Samples were collected in August 2002 by Montana DEQ and US Environmental Protection Agency personnel. Sample designations and site locations are indicated in Table 1a. The site selection and sampling method employed were those recommended in the Montana Department of Environmental Quality (DEQ) Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). The “traveling kick” collection procedure was employed for the samples; duration and length for only two of the samples was provided and are indicated in Table 1b. Aquatic invertebrate samples were delivered to Rhithron Associates, Inc., Missoula, Montana, for laboratory and data analyses.

In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

Table 1a. Sample designations and locations. Sites are listed by drainage in upstream-to-downstream order. Sullivan and Skyland Creeks, August 2002.

Site	***Station ID***	***Activity ID***	***Location Description***	***Latitude/ Longitude***
SUL1	C08SULLC01	02-C200-M	Sullivan Creek above confluence with Conner Creek	47°0'58.536"/113°0'40.122"
SUL2	C08SULLC02	02-C201-M	Sullivan Creek below Quintonkian	48°0'1.668"/113°0'42.312"
SKY	C08SKYLC01	02-C202-M	Skyland Creek above confluence with Bear Creek	48°0'17.574"/113°0'23.34"

Table 1b. Sample collection procedure, duration, and length. Sullivan and Skyland Creeks, August 2002.

Site	**Sampling Date**	**Collection Procedure**	**Duration**	**Length**
SUL1	8-22-02	KICK	Not recorded	Not recorded
SUL2	8-22-02	KICK	2 MINUTES	40 FEET
SKY	8-23-02	KICK	1:21 MINUTES	20 FEET

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of western Montana ecoregions (Bollman 1998a) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998a). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

The six metrics comprising the bioassessment index used in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998a). In addition, they are relevant to the kinds of impacts that are present in Sullivan and Skyland Creeks. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998a). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. **Ephemeroptera (mayfly) taxa richness.** The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific

conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. **Plecoptera (stonefly) taxa richness.** Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. **Trichoptera (caddisfly) taxa richness.** Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. **Number of sensitive taxa.** Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998a).

5. **Percent filter feeders.** Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* spp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. **Percent tolerant taxa.** Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3b.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998a).

	Score			
Metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table 3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment and heavy filamentous algae growth (Bollman 1998b). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a

correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998a). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).

- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.
- Number of "clinger" taxa. So-called "clinger" taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate "clingers" are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected "clinger" taxa richness in unimpaired streams of western Montana is at least 14 (Bollman 1998b).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman 1998b).

RESULTS

Habitat Assessment

Table 4 shows the habitat parameters evaluated, parameter scores and overall habitat evaluations for the study sites. Overall habitat conditions received positive evaluations; all sites studied were categorized as optimal.

At the upper site on Sullivan Creek (SUL1), assessment of the instream habitat parameters suggested that benthic substrates were somewhat less diverse than expected, although no appreciable sediment deposition or embeddedness was noted. Flow conditions were judged sub-optimal. Streambank stability and vegetation appeared sub-optimal, and the riparian zone width was mildly abbreviated.

At the lower site on Sullivan Creek (SUL2), some sediment deposition was reported, and benthic substrate diversity was somewhat depressed. Sub-optimal flow conditions were noted here. Streambank stability was judged marginal on one side of the channel and sub-optimal on the other side; some disruption of vegetative protection was appraised. Riparian zone width appeared to be somewhat foreshortened.

Benthic substrates were mildly embedded, and sediment deposition was noted in the evaluated reach of Skyland Creek (SKY). Substrates were less diverse than expected. Streambanks were judged stable, although some disruption of vegetation was reported, and some erosion potential was reported relative to higher floodplain terraces. On one side of the channel, mild abbreviation of the riparian zone was noted.

Table 4. Stream and riparian habitat assessment. All 3 sites were assessed based upon criteria developed by Montana DEQ for streams with riffle/run prevalence. Site locations are given in Table 1a. Sullivan and Skyland Creeks, August 2002.

Max. possible score	Parameter	SUL1	SUL2	SKY
10	Riffle development	10	10	9
10	Benthic substrate	8	8	8
20	Embeddedness	20	20	15
20	Channel alteration	20	20	20
20	Sediment deposition	20	15	15
20	Channel flow status	14	14	19
20	Bank stability	8 / 6	5 / 3	9 / 9
20	Bank vegetation	8 / 6	8 / 7	8 / 6
20	Vegetated zone	8 / 8	8 / 6	8 / 9
160	Total	136	124	135
	Percent of maximum	**85%**	**78%**	**84%**
	CONDITION*	**OPTIMAL**	**OPTIMAL**	**OPTIMAL**

Condition categories: Optimal > 80% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%. (Plafkin et al. 1989).

Bioassessment

Table 5 itemizes each contributing metric and shows individual metric scores for each site. Tables 3a and 3b above show criteria for use-support categories (Bukantis 1998) and impairment classifications (Plafkin et al. 1989) recommended by Montana DEQ.

When this bioassessment method is applied to these data, resulting scores suggest that all 3 evaluated sites fully supported designated uses, and were essentially unimpaired biologically. Invertebrate assemblages, metric performances, and scoring were remarkably similar among the sites studied.

Aquatic invertebrate communities

Interpretations of biotic integrity in this report are made without reference to results of habitat assessments, or any other information about the sites or watersheds that may have accompanied the invertebrate samples. Interpretations are based entirely on: the taxonomic and functional composition of the sampled invertebrate assemblages; the sensitivities, tolerances, physiology, and habitus information for individual taxa gleaned from the writer's research; the published literature, and other expert sources; and on the performance of bioassessment metrics, described earlier in the report, which have been demonstrated to be useful tools for interpreting potential implications of benthic invertebrate assemblage composition.

High mayfly taxa richness (8) and a low biotic index value (1.27) suggest that water quality at the upper site on Sullivan Creek (SUL1) was unimpaired by nutrients or other pollutants. The site supported 6 cold-stenotherm taxa; cold, clean water appears to have been the rule here. Tolerant organisms composed a larger-than-expected proportion of the sampled animals, but a single taxon comprised the tolerant class at the site. This was the frequently-collected mayfly *Baetis tricaudatus*. The designation of this animal as "tolerant" may be

Table 5. Metric values, scores, and bioassessments for 3 sites on Sullivan and Skyland Creeks, August 2002. Site locations are given in Table 1a.

	SITES		
	SUL1	**SUL2**	**SKY**
METRICS		**METRIC VALUES**	
Ephemeroptera richness	8	8	7
Plecoptera richness	4	5	4
Trichoptera richness	5	6	7
Number of sensitive taxa	7	6	4
Percent filterers	0	0	0
Percent tolerant taxa	17.68	11.74	25.14
		METRIC SCORES	
Ephemeroptera richness	3	3	3
Plecoptera richness	3	3	3
Trichoptera richness	3	3	3
Number of sensitive taxa	3	3	3
Percent filterers	3	3	3
Percent tolerant taxa	1	1	1
TOTAL SCORE (max.=18)	16	16	16
PERCENT OF MAX.	**89%**	**89%**	**89%**
Impairment classification*	**NON**	**NON**	**NON**
USE SUPPORT †	**FULL**	**FULL**	**FULL**

† Use support designations: See Table 3a.
* Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.

questionable; arguably, in this case ubiquity has been confused with tolerance.

Fourteen “clinger” taxa were among the sampled assemblage, and 5 caddisfly taxa were present. These findings suggest that fine sediment deposition did not substantially limit hard substrate habitats. The overall taxa richness (24) seems low, but probably within expectations for a small montane stream. No fewer than 6 predator taxa were present at the site, suggesting that instream habitats were varied and available. Reach-scale habitat features, such as riparian zone function, streambank stability, and natural channel morphology were likely intact; four stonefly taxa were collected, and the richness of this insect order may be associated with large-scale habitat integrity. Among the stoneflies present at the site were the sensitive perlodids *Kogotus* sp. and *Megarcys* sp. Long-lived taxa were notably scarce; only 2 taxa were collected, and each was represented by but a single individual. Surface flow may be seasonal at this site. All expected functional components of an intact montane assemblage were present in the sample, but shredders were not as abundant as expected. This may be due to limited riparian inputs of large organic debris or to hydrologic conditions unfavorable for the retention of this material.

Cold water of excellent quality appears to have persisted downstream; at the lower site on Sullivan Creek (SUL2); a low biotic index value (1.32) complemented high mayfly taxa richness (8). Among the 5 cold-stenotherm taxa collected here were the mayfly *Drunella doddsi*, and caddisflies in the Rhyacophila Iranda Group. *Baetis tricaudatus* was the sole “tolerant” taxon collected.

Stony benthic substrate habitats do not appear to have been compromised by fine sediment deposition, since 6 caddisfly taxa and 16 “clinger” taxa were supported at the site. Other instream habitats were probably diverse and undisturbed; this hypothesis is supported by the fact that no fewer than 10 predator taxa were present in the sample. Twenty-eight taxa

occurred in the sampled assemblage, a number that seems low, but is probably consistent with a small montane stream in good condition. Five stonefly taxa were collected, suggesting that reach-scale habitat features were not deficient. The site supported only a single semivoltine taxon, which could be related to a seasonal diminishment of surface flow. The functional composition of the assemblage was composed of all expected contributors, but similar to the upper site, this reach supported fewer shredders than expected. Lack of riparian inputs or unfavorable hydrologic conditions may explain the poor representation of this group.

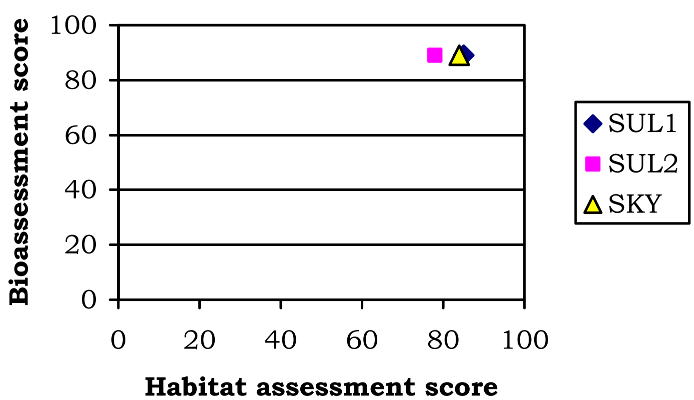
High mayfly taxa richness (7) and a low biotic index value (2.47) are evidence for unpolluted water at the site on Skyland Creek (SKY). Five cold-stenotherm taxa were present here, including the dipteran *Glutops* sp., and the stonefly *Yoraperla* sp. Cold water temperatures are indicated by these faunal elements. The (perhaps) unfairly maligned mayfly *Baetis tricaudatus* composed the "tolerant" class of organisms at the site.

Fine sediment deposition did not substantially impair substrate habitats, since 13 "clinger" taxa were collected, as well as 7 caddisfly taxa, including at least 5 species in the genus *Rhyacophila.* The total number of taxa (29) in the assemblage was within expected limits for a small montane system; ten of these taxa were predators. These findings suggest that instream habitats were diverse and available. No long-lived taxa appeared in the sampled assemblage, suggesting that surface flow may not persist year-round at this site. The site supported at least 4 species of stoneflies, which could indicate that reach-scale features such as streambanks, riparian zones, and channel morphology were basically functional. The functional composition of the assemblage included all expected groups in appropriate proportions.

CONCLUSION

- All 3 of the sites appraised in this study supported sensitive assemblages of invertebrates, suggesting excellent water quality and good instream and reach-scale habitat. Diversity appeared to be appropriate for small montane watersheds. The scarcity of long-lived taxa at these sites could imply seasonal diminishment of surface flow. Figure 1 plots bioassessment scores against habitat assessment scores. Symbols representing the 3 sites fall into the area of the graph that suggests both excellent water quality and good habitat conditions.

Figure 1. Total bioassessment scores plotted against habitat assessment scores for sites on Sullivan and Skyland Creeks, August 2002. (After Barbour and Stribling 1991).



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Sites on Sullivan and Skyland Creeks

Taxonomic data and metric summaries

August 2002

A Biological Assessment of Sites on The North and Middle Forks of The Flathead River Drainage: Flathead County, Montana

August and September 2003

A report to

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by

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INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected in August and September 2003 from sites on the North and Middle Forks of the Flathead River drainage in Flathead County, Montana. Aquatic invertebrate assemblages were sampled by personnel of the U.S. EPA Region 8. All of the study sites lie within the Northern Rockies ecoregion (Woods et al. 1999).

A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is "…a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment…" (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "… an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition" (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1996). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998a). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied enhances the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat measures and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998a) has studied the assemblages of the Montana Valleys and Foothill Prairies ecoregion and has recommended a battery of metrics applicable to the montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to measures of habitat integrity, and consistent over replicated samples.

METHODS

Samples were collected in August and September 2003 by U.S. EPA personnel. Sample designations and site locations are indicated in Table 1. The site selection and sampling method employed were those recommended in the MT DEQ Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). Aquatic invertebrate samples were delivered to Rhithron Associates, Inc., Missoula, Montana, for laboratory and data analyses.

In the laboratory, the MT DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with MT DEQ protocols.

Table 1. Sample designations and locations. Sites are listed by drainage in upstream-to-downstream order. North and Middle Forks of the Flathead River drainage, August and Septemebr 2003.

Site	Sampling Date	Station ID	Activity ID	Location Description	Latitude/ Longitude	Kick Length / Duration
North Fork of the Flathead River						
WHAL02	08-27-03	C06WHALC02	03-0930-M	WHALE CREEK UPPER	48.85988/114.54779	50 FEET/7 MIN
WHAL01	08-27-03	C06WHALC01	03-0929-M	WHALE CREEK @ NORTH FORK BRIDGE	48.85146/114.36242	100 FEET/7:30 MIN
RDM	08-27-03	C06RDMEC01	03-0931-M	RED MEADOW CREEK	48.80707/114.34727	150 FEET/10 MIN
COLN	08-27-03	C06COLNC01	03-0935-M	NORTH FORK COAL CREEK	48.69178/114.37678	125 FEET/12:45 MIN
COLS	08-27-03	C06COLSC01	03-0934-M	SOUTH FORK COAL CREEK	48.67474/114.40942	100 FEET/15 MIN
COAL01	08-27-03	C06COALC01	03-0933-M	COAL CREEK @ DEADHORSE	48.67480/114.31652	200 FEET/10 MIN
COAL02	08-27-03	C06COALC02	03-0932-M	COAL CREEK ON NORTH FORK ROAD	48.68819/114.19916	200/10:30 MIN
Middle Fork of the Flathead River						
MORS	08-26-03	C07MORSC01	03-0927-M	MORRISON CREEK	48.21572/113.29020	100 FEET/14 MIN
CHLG	08-26-03	C07CHLGC01	03-0928-M	CHALLENGE CREEK	48.23018/113.33150	150 FEET/15 MIN
GRNT	09-10-03	C07GRNTC02	03-0937-M	GRANITE CREEK	48.22313/113.33156	70 FEET/15:27 MIN
OLE	09-29-03	C07OLEC01	03-0936-M	OLE CREEK	48.28003/113.59547	70FEET/14 MIN

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of western Montana ecoregions (Bollman 1998a) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank, and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998a). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

The six metrics comprising the bioassessment index used in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998a). In addition, they are relevant to the kinds of impacts that are present in the Flathead River basin. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998a). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. **Ephemeroptera (mayfly) taxa richness.** The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.
2. **Plecoptera (stonefly) taxa richness.** Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.
3. **Trichoptera (caddisfly) taxa richness.** Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.
4. **Number of sensitive taxa.** Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998a).
5. **Percent filter feeders.** Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some

filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* sp. and *Parapsyche* spp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. **Percent tolerant taxa.** Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998a).

	Score			
Metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by MT DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3b.

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table 3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment and heavy filamentous algae growth (Bollman 1998b). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998a). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.

- Number of “clinger” taxa. So-called “clinger” taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate “clingers” are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected “clinger” taxa richness in unimpaired streams of western Montana is at least 14 (Bollman 1998b).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman 1998b).

RESULTS

Bioassessment

Figure 1 summarizes bioassessment scores for aquatic invertebrate communities sampled at the 11 sites in this study. Tables 4a and 4b itemizes each contributing metric and shows individual metric scores for each site. Tables 3a and 3b above show criteria for use-support categories recommended by MT DEQ (Bukantis 1998) and impairment classifications (Plafkin et al. 1989). Macroinvertebrate taxa lists, metric results and other information for each sample are given in the Appendix.

When this bioassessment method is applied to these data, scores were generally high, and indicated that all sites except one were non-impaired. Sampled assemblages from 6 of the 11 sites yielded maximal scores. The lower site on Whale Creek rated the lowest bioassessment score, indicating slight impairment. All sites fully supported designated uses.

Aquatic invertebrate communities

Interpretations of biotic integrity in this report are made without reference to results of habitat assessments, or any other information about the sites or watersheds that may have accompanied the invertebrate samples. Interpretations are based entirely on: the taxonomic and functional composition of the sampled invertebrate assemblages; the sensitivities, tolerances, physiology, and habitus information for individual taxa gleaned from the writer’s research; the published literature, and other expert sources; and on the performance of bioassessment metrics, described earlier in the report, which have been demonstrated to be useful tools for interpreting potential implications of benthic invertebrate assemblage composition.

Whale Creek

At the upstream site on Whale Creek, the sample yielded 10 mayfly taxa, and the calculated biotic index for the assemblage was low (2.41). These findings suggest that water quality at the site was very good. The site supported at least eight cold stenotherm taxa, including the stonefly *Despaxia augusta* and the dipteran *Rhabdomastix* sp. Cold, clean water was apparently the rule at this site.

Twenty “clinger” taxa and 5 caddisfly taxa were taken in the sample, suggesting that hard benthic substrates were probably not contaminated by excessive fine sediment deposition. Instream habitats generally seem to have been complex, since taxa richness was high (34) and at least 14 predator taxa were present at the site. Five stonefly taxa were collected; the richness of the stonefly fauna may be associated with the quality of reach-scale habitat features, such as riparian zone function, streambank stability, and natural channel morphology. The sampled

assemblage suggests that these features were probably intact. Semivoltine taxa were underrepresented at the site; only 2 such taxa were present in the sample. This may indicate that long life cycles were recently interrupted by some catastrophic event, such as dewatering, large sediment inputs, or thermal or chemical pollution events. Although all expected functional components were present in the sampled assemblage, collectors dominated the mix.

Figure 2. Total bioassessment scores compared among sites in the North and Middle Forks of the Flathead River drainage, August and September 2003. The revised Montana bioassessment method (Bollman 1998b) was used to determine scores. Scores are reported as the percent of maximum possible score.

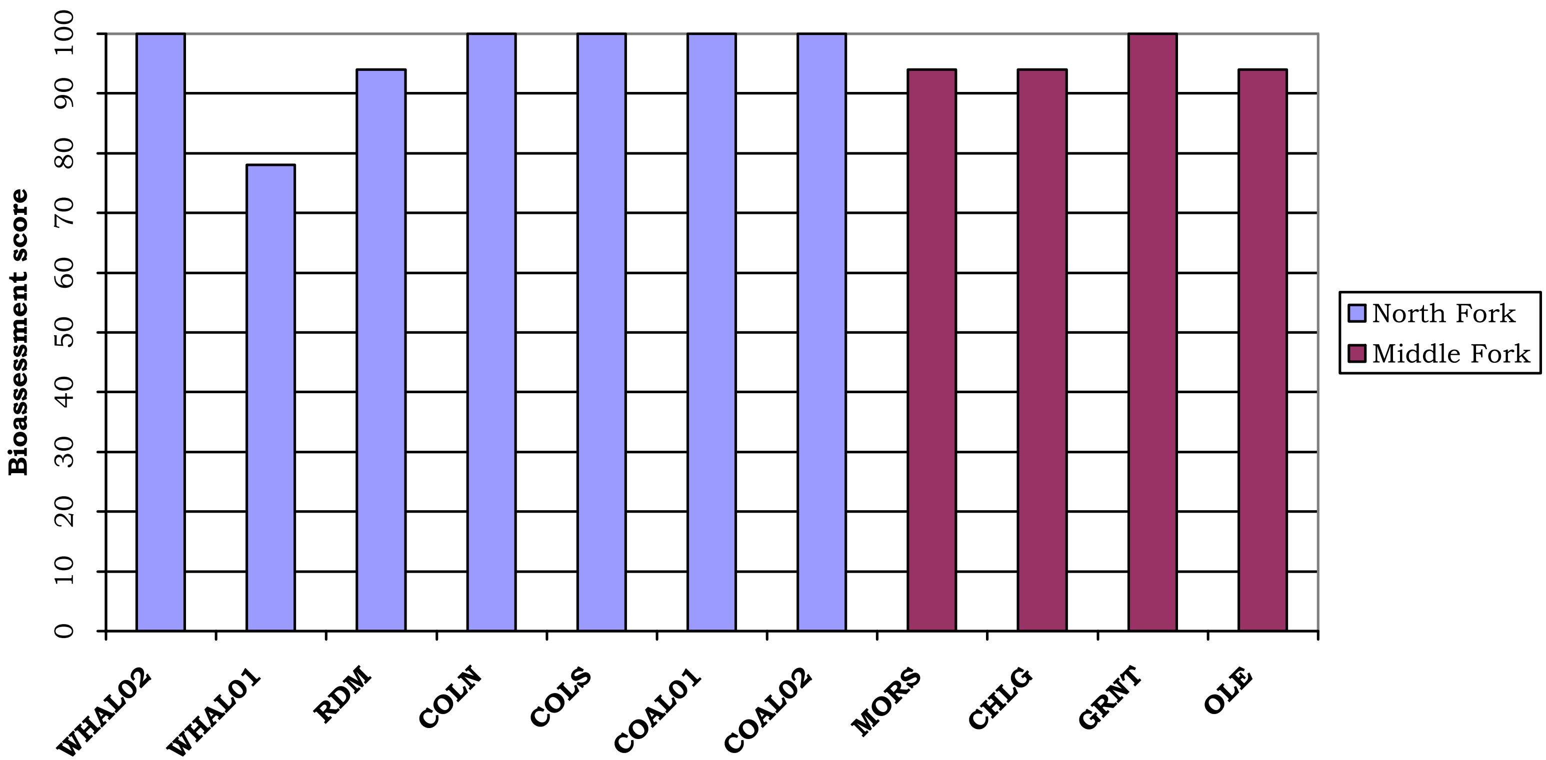

Table 4a. Metric values, scores, and bioassessments for sites in the North Fork of the Flathead River Drainage, August 2003. Site locations are given in Table 1.

	SITES						
	WHAL02	**WHAL01**	**RDM**	**COLN**	**COLS**	**COAL01**	**COAL02**
METRICS				**METRIC VALUES**			
Ephemeroptera richness	10	9	11	10	8	12	9
Plecoptera richness	5	5	7	8	8	5	4
Trichoptera richness	5	4	9	9	5	6	6
Number of sensitive taxa	10	5	9	12	11	11	7
Percent filterers	2.20	48.66	7.54	3.77	0.59	2.11	9.54
Percent tolerant taxa	0.0	0.0	0.0	0.0	0.0	0.0	0.58
				METRIC SCORES			
Ephemeroptera richness	3	3	3	3	3	3	3
Plecoptera richness	3	3	3	3	3	3	3
Trichoptera richness	3	2	3	3	3	3	3
Number of sensitive taxa	3	3	3	3	3	3	3
Percent filterers	3	0	2	3	3	3	2
Percent tolerant taxa	3	3	3	3	3	3	3
TOTAL SCORE (max.=18)	18	14	17	18	18	18	17
PERCENT OF MAX.	**100%**	**78%**	**94%**	**100%**	**100%**	**100%**	**94%**
Impairment classification*	**NON**	**SLI**	**NON**	**NON**	**NON**	**NON**	**NON**
USE SUPPORT †	**FULL**	**FULL**	**FULL**	**FULL**	**FULL**	**FULL**	**FULL**

* Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.
† Use support designations: See Table 3a.

Table 4b. Metric values, scores, and bioassessments for sites in the Middle Fork of the Flathead River Drainage, August and September 2003. Site locations are given in Table 1.

	SITES			
	MORS	**CHLG**	**GRNT**	**OLE**
METRICS		**METRIC VALUES**		
Ephemeroptera richness	8	8	8	7
Plecoptera richness	7	5	5	3
Trichoptera richness	4	7	6	7
Number of sensitive taxa	10	9	7	6
Percent filterers	0.0	5.34	0.0	0.53
Percent tolerant taxa	0.30	0.0	0.0	0.0
		METRIC SCORES		
Ephemeroptera richness	3	3	3	3
Plecoptera richness	3	3	3	2
Trichoptera richness	2	3	3	3
Number of sensitive taxa	3	3	3	3
Percent filterers	3	2	3	3
Percent tolerant taxa	3	3	3	3
TOTAL SCORE (max.=18)	17	17	18	17
PERCENT OF MAX.	**94%**	**94%**	**100%**	**94%**
Impairment classification*	**NON**	**NON**	**NON**	**NON**
USE SUPPORT †	**FULL**	**FULL**	**FULL**	**FULL**

* Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.
† Use support designations: See Table 3a.

At the North Fork bridge, Whale Creek supported an assemblage that included 9 mayfly taxa; in addition, the biotic index value (2.45) was within expectations for a montane stream. Good water quality is indicated by these findings. Five cold-stenotherm taxa made up 23% of sampled animals. Among these sensitive taxa were the mayfly *Drunella doddsi* and the nemourid stonefly *Zapada columbiana*. The high proportion of taxa such as these strongly suggests that cold, unpolluted water characterized this site.

Sixteen “clinger” taxa were among the animals sampled, but only 4 caddisfly taxa were collected. Richness of these groups are associated with clean stony substrates uncontaminated by fine sediment deposition. The relatively low diversity of caddisflies in this sample is likely the result of the domination of blackfly larvae (*Simulium* sp. and *Prosimulium* sp.), which together made up 48% of the sampled assemblage. Large numbers of blackfly larvae can compromise the availability of substrate space for other “clingers”. It appears that fine sediment deposition did not substantially impair habitat quality at this site. High overall taxa richness (31) and a diverse predator fauna (9 taxa) suggest varied instream habitats. Reach-scale habitat features, such as riparian zone function, streambank integrity, and natural channel morphology were likely intact, since the stonefly fauna richness was high (5 taxa). Like the upper site, only a few long-lived taxa were collected. All expected functional components

were present, but shredders were underrepresented and filter-feeders overwhelmed the functional mix. This suggests plentiful fine organic material in suspension.

Red Meadow Creek

A single site on Red Meadow Creek was sampled for this study. Eleven mayfly taxa were collected there, and the biotic index value (2.63) was low. Water quality was apparently unimpaired by nutrient pollution. Nine of the taxa present in the sample were cold-stenotherms. Taken together, the water quality indicators calculated for this sampled assemblage suggest cold, clean water.

Invertebrate indicators of fine sediment deposition gave positive results as well; the site supported no fewer than 23 “clinger” taxa and 9 Trichoptera taxa. The fauna included the chloroperlid stoneflies *Kathroperla* sp and *Paraperla* sp., both of which are associated with hyporheic habitats. These findings indicate the probability that stony substrate habitats were not contaminated by fine sediment deposition here. Other instream habitats were apparently intact and available, since overall taxa richness was very high (47) and 15 of the collected taxa were predators. Seven stonefly taxa were among the sampled animals; these included the leuctrid *Despaxia augusta*, and the sensitive perlid *Doroneuria* sp. Stonefly taxa richness may be associated with reach-scale habitat features; the diverse Plecoptera fauna at this site suggests that these features were probably essentially intact. Six long-lived taxa were collected and some of these were abundant, implying that year-round surface flow was uninterrupted here, and no other recent catastrophes were likely to have aborted long life cycles. Shredders were underrepresented in the functional mix, but all expected components were present.

Coal Creek watershed

The sample taken on the North Fork of Coal Creek yielded 10 mayfly taxa, and the biotic index value of 2.18 was low; these findings imply good water quality. Among the 9 cold-stenotherm taxa present in the sample were the sensitive ephemerellid *Caudatella* sp. and the predatory net-spinner *Parapsyche elsis*. Cold, clean water can be assumed.

Stony substrates without fine sediment deposition also appear to be indicated by the invertebrate assemblage; 25 of the collected taxa were “clingers” and 9 were caddisflies. In addition, the hyporheic taxa *Kathroperla* sp. and *Paraperla* sp. were present here. A variety of other instream habitats were apparently available, since the site supported at least 41 invertebrate taxa, 14 of which were predators. Reach-scale habitat features, such as streambank integrity, riparian zone function, and natural channel morphology were probably essentially intact since 8 stonefly taxa were collected. Only 3 long-lived taxa were present in the sample; however, these taxa made up 19% of sampled animals, and included taxa such as the perlid *Doroneuria* sp., which are not considered to be pioneers. It seems unlikely that catastrophes such as dewatering or scouring sediment pulses obliterated the fauna in the recent past. All expected functional components of a healthy montane stream were present at the site.

Good water quality and cold temperatures appeared to characterize the sampled site on the South Fork of Coal Creek. The low biotic index value (2.25) and the high mayfly taxa diversity (8 taxa) support this notion. Nine sensitive cold-stenotherm taxa were collected, including the mayfly *Drunella doddsi*, and the perlodid stonefly *Megarcys* sp.

High diversity of both “clingers” (19 taxa) and caddisflies (5 taxa) suggest that fine sediment did not compromise hard benthic substrate habitats. The presence of *Paraperla* sp. in the sample seems to support this hypothesis. Other instream habitats were probably abundant and intact, since overall diversity of the assemblage was high (37 taxa) and at least 18 predator taxa were supported at the site. The high stonefly richness suggests that reach-scale habitat features were likely intact; 8 stonefly taxa were collected. Only 3 semivoltine taxa were taken in the sample, but since *Parapsyche elsis* and *Doroneuria* sp. were among them, it seems unlikely that a recent disaster occurred here. These taxa are not opportunistc colonizers of disturbed habitats. All expected elements composed the functional mix; collectors were somewhat more abundant than expected.

The mainstem of Coal Creek was sampled at 2 sites. At Deadhorse, the upstream site, 12 mayfly taxa and a biotic index value of 2.64 indicated that water quality was unimpaired by either thermal impacts or nutrient pollution. Among the 8 cold-stenotherm taxa taken in the sample were caddisflies in the Rhyacophila Iranda Group, and the dancefly *Oreogeton* sp. These findings suggest that cold, clean water characterized this site.

No fewer than 23 "clinger" taxa were supported here, and the Trichoptera taxa richness was high (6). Access to hyporheic habitats was indicated by the presence of the chloroperlid stonefly *Kathroperla* sp. Fine sediment deposition apparently did not compromise benthic habitats. Instream habitats in general were probably abundantly available, since 13 predator taxa were collected, and the overall taxa richness was high (39). The rich stonefly fauna (5 taxa) suggests that reach-scale features such as natural channel morphology, riparian function, and streambank stability were unimpaired. Semivoltine taxa were underrepresented; only 2 such taxa were present in the sampled assemblage. Of these, the elmid *Heterlimnius* sp. is often the first long-lived taxa to appear after catastrophic disturbance. The other semivoltine taxa present was *Parapsyche elsis*, which is not a pioneering species but was apparently not particularly abundant at the site; only 7 individuals were taken in the sample. Whether these findings can be interpreted as evidence of recent obliteration of long-lived species is not clear. While the functional composition of the invertebrate assemblage included all expected components, shredders were underrepresented.

Downstream, at the North Fork Road, the sampled site on Coal Creek yielded 9 mayfly taxa, including the sensitive ephemerellids *Drunella doddsi* and *Drunella spinifera*. The high Ephemeroptera taxa richness, plus the low biotic index value (2.79) suggest that water quality was good at this site. Seven cold-stenotherm taxa were present in the sample; cold, clean water is implied by these findings.

The site supported at least 16 "clinger" taxa and 6 caddisfly taxa. Richness in these groups is associated with stony benthic substrates free from fine sediment deposition. A rich predator fauna (9 taxa) and the overall diversity of invertebrates (33 taxa) suggest that instream habitats were complex and available. Large-scale habitat features were also likely to have been intact, since stonefly taxa richness (4) was within expectations for a montane system. Four semivoltine taxa were found in the sample; dewatering or other catastrophes seem unlikely to have occurred recently. Scrapers were prominent in the functional mix, and shredders were correspondingly scarce. This pattern is consistent with limited shading and sparse input of large organic material from riparian vegetation.

Morrison Creek

A single site on Morrison Creek was sampled; the assemblage it supported included at least 8 mayfly taxa and produced a biotic index value of 2.40. Both findings support a hypothesis of good water quality at this site. Ten sensitive cold-stenotherm taxa were among the animals sampled here; they included the heptageniid *Epeorus grandis* and the peltoperlid *Yoraperla brevis*. Cold water unimpaired by nutrient pollution appears to have characterized the site.

Fifteen "clinger" taxa and 4 caddisfly taxa were collected. While the number of "clinger" taxa is within expectations, caddisfly taxa richness is slightly lower than expected. Nevertheless, "clingers" made up 76% of sampled animals, suggesting that benthic substrates were probably clean and that fine sediment deposition did not substantially impair biotic potential here. The high overall taxa richness (35) and diverse predator fauna (17 taxa) make it seem likely that abundant varied instream habitats were intact. Riparian zone function, streambank integrity, and other reach-scale habitat features were probably also unimpacted by human-caused disturbances, since the stonefly fauna was rich (7 taxa) and included at least 5 intolerant taxa, such as *Despaxia augusta* and *Zapada columbiana*. Three long-lived taxa were present in the sample; among these were *Parapsyche elsis* and *Doroneuria* sp., which are not likely to be early colonizers. It seems unlikely that this site was recently dewatered or subjected to other catastrophic disruptions recently. All expected functional components of a healthy montane stream were present here, and their proportional contributions to the assemblage appeared to be appropriate.

Challenge Creek

A single sample was collected from Challenge Creek. A low biotic index value (2.65) and high mayfly taxa richness (8) imply good water quality at this site. Cold-stenotherms were represented by 9 taxa, including caddisflies in the Rhyacophila Iranda Group and the midge *Cricotopus nostococladius*. These findings indicate cold, clean water.

The fauna included 18 "clinger" taxa and 7 caddisfly taxa, suggesting that fine sediment deposition did not limit benthic colonization here. Other instream habitats appear to have been varied, complex, and available, since taxa richness (34) was high and 15 predator taxa were supported at the site. The diverse Plecoptera fauna (5 taxa) was probably associated with intact reach-scale habitat features such as undisturbed channel morphology and well vegetated, stable streambanks. Four semivoltine taxa were among the sampled animals, suggesting that catastrophic scours or dewatering did not recently abort long lives. The functional mix contained all expected components, but scrapers were not abundant. Shredders, however, were plentiful, implying ample riparian inputs of large organic material as well as hydrologic conditions conducive to its retention.

Granite Creek

The single sample collected from Granite Creek yielded 8 mayfly taxa and an overall biotic index value of 1.85, the lowest value of any site in this study. Excellent water quality is suggested by these findings. The dominant organism in the sampled assemblage was the sensitive cold-stenotherm *Drunella doddsi*, one of the 7 such taxa present. In addition to the lack of nutrient pollution, there were also apparently no thermal challenges to the fauna in this montane stream.

Fifteen "clinger" taxa and 6 caddisfly taxa are strong evidence that stony substrates were not contaminated by fine sediment deposition. Taxa richness (26) was somewhat lower than expected, but the presence of 13 predator taxa suggests that instream habitats were varied and intact. Reach-scale habitat features were likely not disturbed, since the site supported at least 5 stonefly taxa, 4 of which are sensitive animals. These include *Yoraperla brevis* and the nemourid *Zapada columbiana*. Only 2 semivoltine taxa appeared in the sampled assemblage; a recent catastrophe such as dewatering, a scouring sediment pulse, or toxic input cannot be ruled out. All of the expected functional components of a montane stream were present in appropriate proportions.

Ole Creek

The fauna of Ole Creek were represented by a single collection. The assemblage was apparently not impaired by nutrient pollution or other water quality disturbances, since the biotic index value (2.02) was within expectations for a clean mountain stream. Cold water is indicated by the presence of at least 5 cold-stenotherm taxa, including *Drunella doddsi* and the uenoid caddisfly *Oligophlebodes* sp.

Only 14 "clingers" were collected, but the caddisfly fauna was rich (7 taxa). Nearly 90% of sampled animals were "clingers", which implies that there were large areas of clean benthic substrates available for colonization. Little or no fine sediment deposition seems to have compromised these habitats. Overall taxa richness was lower than expected; only 22 taxa were present in the sampled assemblage. The predator fauna (7 taxa) was also not as rich as expected. These findings could be associated with relatively monotonous instream habitats, compared to the other sites sampled for this study. Somewhat fewer stonefly taxa (3) than expected were found in the sample; there may have been some disruption to reach-scale habitat features, such as riparian zone function, streambank integrity, or natural channel morphology. A few long-lived animals in 3 taxa were present. The most abundant of these was the caddisfly *Arctopsyche grandis*, the presence of which suggests that dewatering or other life-cycle interruptions were not recent events here. Scrapers overwhelmed other functional components, suggesting little riparian shading, with dense algal films resulting. Shredders were correspondingly underrepresented, which may have been associated with a paucity of

riparian inputs of large organic material or hydrologic conditions that did not favor retention of such material.

CONCLUSIONS

- Low biotic index values and high mayfly taxa richness at all sampled sites suggests that nutrients or other pollutants did not limit biotic health at any site in this study. Abundant cold-stenotherms indicate that thermal impacts also were not a limiting factor at any site.
- Fine sediment deposition probably did not affect instream habitats at any site. Instream habitat conditions at most sites were unimpaired. Monotonous conditions may have been indicated at Ole Creek.
- Reach-scale habitat features may have been disturbed to some extent at Ole Creek; indicators at the other sites suggested that benthic assemblages were unaffected by such perturbations.
- Invertebrate assemblage composition could be interpreted to suggest that recent dewatering, scouring sediment pulses, or other disturbances may possibly have affected benthos at Whale Creek, the upstream site on Coal Creek, and Granite Creek.

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Sites in the Flathead River Drainage

Taxonomic data and metric summaries

August and September 2003

Biological Integrity of Sullivan Creek and Skyland Creek in the Upper Flathead River TMDL Planning Area Based on the Structure and Composition of the Benthic Algae Community

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Summary

In August 2002, periphyton samples were collected from 2 sites on Sullivan Creek and 1 site on Skyland Creek in the upper Flathead River TMDL planning area in northwestern Montana for the purpose of assessing whether these streams are water-quality limited and in need of TMDLs. The samples were collected following MDEQ standard operating procedures, processed and analyzed using standard methods for periphyton, and evaluated following modified USEPA rapid bioassessment protocols for wadeable streams.

Hydrurus foetidus was the most abundant alga at all three sites. This cold-water stenotherm thrives in flashy mountain streams that have unstable channels and exhibit wide seasonal fluctuations in flow, temperature, and turbidity. *H. foetidus*, a chrysophyte, grows best in full sunlight and achieves maximum standing crop in winter and spring when flows are stable and turbidity is low.

Sullivan Creek above Connor Creek was subject to major environmental stresses that were natural in origin. The cold-water stenotherm and pollution-sensitive diatom *Hannaea arcus* accounted for over 80% of the diatom assemblage at this site. Although diatom species richness, equitability, and diversity were very low, values for the pollution index, sedimentation index, and percent abnormal cells indicated excellent water quality at this site. The stresses detected here were probably due to cold temperatures, low nutrient concentrations, steep gradients, and/or fast current velocities.

A significant increase in organic loading was detected at the site on **Sullivan Creek below Quintonkon Creek**, resulting in **minor impairment**. The dominant diatom species here was *Fragilaria vaucheriae,* a species that is somewhat tolerant of organic pollution. Modal categories for diatom ecological attributes indicate reduced availability of dissolved oxygen at this site and an increase in both organic and inorganic nutrients.

Diatom metrics indicate even greater organic loading in **Skyland Creek above Bear Creek**, resulting in **moderate impairment**. *Encyonema silesiacum,* a pollution-tolerant diatom, accounted for over half the diatom cells counted at this site. Most diatoms here exert only a moderate demand for dissolved oxygen, as compared to a continuously high demand at the two sites on Sullivan Creek. The modal category for saprobity at the Skyland Creek site was alpha-mesosaprobous, which is the same modal category as the lower site on Sullivan Creek and indicates waters with 25-70% oxygen saturation and 4-13 mg/L BOD.

Introduction

This report evaluates the biological integrity[1], support of aquatic life uses, and probable causes of stress or impairment to aquatic communities in Sullivan Creek and Skyland Creek in the upper Flathead River TMDL planning area in northwestern Montana. The purpose of this report is to provide information that will help the State of Montana determine whether Sullivan Creek and Skyland Creek are water-quality limited and in need of TMDLs.

The federal Clean Water Act directs states to develop water pollution control plans (Total Maximum Daily Loads or TMDLs) that set limits on pollution loading to water-quality limited waters. Water-quality limited waters are lakes and stream segments that do not meet water-quality standards, that is, that do not fully support their beneficial uses. The Clean Water Act and USEPA regulations require each state to (1) identify waters that are water-quality limited, (2) prioritize and target waters for TMDLs, and (3) develop TMDL plans to attain and maintain water-quality standards for all water-quality limited waters.

Evaluation of aquatic life use support in this report is based on the species composition and structure of periphyton (aka benthic algae, phytobenthos) communities at three sites that were sampled in August of 2002. Periphyton is a diverse assortment of simple photosynthetic organisms called algae that live attached to or in close proximity of the stream bottom. Some algae form long filaments or large gelatinous colonies that are conspicuous to the unaided eye. But most algae, including the ubiquitous diatoms, can be seen and identified only with the aid of a microscope. The periphyton community is a basic biological component of all aquatic ecosystems. Periphyton accounts for much of the primary production and biological diversity in Montana streams (Bahls et al. 1992). Plafkin et al. (1989) and Barbour et al. (1999) list several advantages of using periphyton in biological assessments.

[1] *Biological integrity* is defined as “the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region” (Karr and Dudley 1981).

Project Area and Sampling Sites

The project area is located within Level IV ecoregion 41c (Western Canadian Rockies), which is an extension of the Canadian Rockies Ecoregion in Flathead County, Montana (Woods et al. 1999). This is a high, rugged, glaciated region that lies west of the Continental Divide and is affected by moist Pacific maritime air masses. The Western Canadian Rockies are underlain by Precambrian rocks, including argillites and quartzites, and mantled by volcanic ash, glacial drift, and colluvium. Soils are thin or absent on upper mountain slopes but become deeper and more developed below. Climax vegetation consists of Douglas-fir, subalpine fir, grand fir, and Engelmann spruce forests, with alpine tundra on the highest peaks. The main land uses are logging, recreation, and wildlife habitat.

Periphyton samples were collected at two sites on Sullivan Creek and one site on Skyland Creek (Table 1). Sullivan Creek is a west side tributary of Hungry Horse Reservoir in the South Fork Flathead River hydrologic unit (USGS HUC 17010209). Skyland Creek, a tributary of Bear Creek, rises on the west side of the Continental Divide near Marias Pass in the Middle Fork Flathead River hydrologic unit (USGS HUC 17010207). The South Fork, Middle Fork, and North Fork meet to form the Flathead River near West Glacier, Montana. Sullivan Creek and Skyland Creek are classified B-1 in the Montana Surface Water Quality Standards.

Methods

Periphyton samples were collected following standard operating procedures of the MDEQ Planning, Prevention, and Assistance Division. Using appropriate tools, microalgae were scraped, brushed, or sucked from natural substrates in proportion to the importance of those substrates at each study site. Macroalgae were picked by hand in proportion to their abundance at the site. All collections of microalgae and macroalgae were pooled into a common container and preserved with Lugol's (IKI) solution.

The samples were examined to estimate the relative abundance and rank by biovolume of diatoms and genera of soft (non-diatom) algae according to the method described in Bahls

(1993). Soft algae were identified using Smith (1950), Prescott (1962, 1978), John et al. (2002), and Wehr and Sheath (2003). These books also served as references on the ecology of the soft algae, along with Palmer (1969, 1977).

After the identification of soft algae, the raw periphyton samples were cleaned of organic matter using sulfuric acid, potassium dichromate, and hydrogen peroxide. Then permanent diatom slides were prepared using Naphrax, a high refractive index mounting medium, following *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). At least 400 diatom cells (800 valves) were counted at random and identified to species. The following were the main taxonomic references for the diatoms: Krammer and Lange-Bertalot 1986, 1988, 1991a, 1991b; Lange-Bertalot 1993, 2001; Krammer 1997a, 1997b, 2002; Reichardt 1997, 1999. Diatom naming conventions followed those adopted by the Academy of Natural Sciences for USGS NAWQA samples (Morales and Potapova 2000) as updated in 2003 (Dr. Eduardo Morales, Academy of Natural Sciences, digital communication). Van Dam et al. (1994) was the main ecological reference for the diatoms.

The diatom proportional counts were used to generate an array of diatom association metrics. A metric is a characteristic of the biota that changes in some predictable way with increased human influence (Barbour et al. 1999). Diatoms are particularly useful in generating metrics because there is a wealth of information available in the literature regarding the pollution tolerances and water quality preferences of common diatom species (e.g., Lowe 1974, Beaver 1981, Lange-Bertalot 1996, Van Dam et al. 1994).

Values for selected metrics were compared to biocriteria (numeric thresholds) developed for streams in the Rocky Mountain ecoregions of Montana (Table 2). These criteria are based on metric values measured in least-impaired reference streams (Bahls et al. 1992) and metric values measured in streams that are known to be impaired by various sources and causes of pollution (Bahls 1993). The criteria in Table 2 are valid only for samples collected during the summer field season (June 21-September 21) and distinguish among four levels of stress or impairment and three levels of aquatic life use support: (1) no impairment or only minor impairment (full support); (2) moderate impairment (partial support); and (3) severe impairment (nonsupport).

These impairment levels correspond to excellent, good, fair, and poor biological integrity, respectively. In cold, high-gradient mountain streams, natural stressors will often mimic the effects of man-caused impairment on some metric values.

Quality Assurance

Several steps were taken to assure that the study results are accurate and reproducible. Upon receipt of the samples, station and sample attribute data were recorded in the Montana Diatom Database and the samples were assigned a unique number, e.g., 2655-01. The first part of this number (2655) designates the sampling site (Sullivan Creek above Connor Creek) and the second part (01) designates the number of periphyton samples that that have been collected at this site for which data have been entered into the Montana Diatom Database.

Sample observations and analyses of soft (non-diatom) algae were recorded in a lab notebook along with information on the sample label. A portion of the raw sample was used to make duplicate diatom slides. The slide used for the diatom proportional count will be deposited in the Montana Diatom Collection at the University of Montana Herbarium in Missoula. The duplicate slide will be retained by *Hannaea* in Helena. Diatom proportional counts have been entered into the Montana Diatom Database.

Results and Discussion

Results are presented in Tables 3, 4 and 5, which are located near the end of this report following the references section. Copies of aquatic plant field sheets are included in Appendix A. Appendix B contains a diatom report for each sample. Each diatom report includes an alphabetical list of diatom species in that sample and their percent abundances, and values for 65 different diatom metrics and ecological attributes.

Sample Notes

Sullivan Creek above Connor Creek. This sample was sparse and the entire sample was oxidized to make the diatom slides. The *Phormidium* sp. in this sample occurred as an epiphyte on *Hydrurus foetidus. Hannaea arcus* was visually the dominant diatom in this sample.

Sullivan Creek below Quintonkon Creek. This sample was heavier than the one collected upstream. *Hannaea arcus* was the visual dominant among the diatoms in this sample.

Skyland Creek above Bear Creek. This sample was poorly preserved and in the process of decomposing. It was black and smelled strongly of hydrogen sulfide. The visually dominant diatoms in this sample were *Encyonema silesiacum and Hannaea arcus*.

Non-Diatom Algae (Table 3)

Hydrurus foetidus ranked first in biovolume in samples from all three sites (Table 3). Nicholls and Wujek (2003) reviewed the biology of this common alga of mountain streams:

> One of the most dramatic examples of a cold-water stenotherm is the mountain-stream-dwelling chrysophyte *Hydrurus foetidus*. This macroscopic, brown, gelatinous, unpleasant-smelling alga is relatively abundant in both the eastern and western mountain streams of North America. The gelatinous envelope in which the cells are embedded is exceedingly tough and the plant frequently covers the entire surface of submerged rocks and has caused more than one hiker to lose his or her footing when crossing a stream. It normally begins to disappear when water temperatures rise much above 10^{o}C…Other requirements for this species apparently include low pH and bright sunlight.

Hydrurus foetidus often dominates the winter and spring algal communities of glacier-fed streams of the Swiss Alps, which exhibit unstable channels and wide seasonal fluctuations in flow, temperature, and turbidity (Hieber et al. 2001). Elsewhere, Kawecka (1990) reported that *Hydrurus foetidus* (along with *Ulothrix zonata*) dominated the algal communities of unregulated streams in a study of paired regulated and unregulated streams.

Sullivan Creek above Connor Creek. Diatoms, which were abundant, ranked second to *Hydrurus foetidus* in terms of total biomass, followed by the filamentous cyanobacterium

Phormidium, which was frequent. The branched filamentous green alga *Stigeoclonium* and the filamentous cyanophyte *Amphithrix* were occasional components of the algal flora at this site.

Sullivan Creek below Quintonkon Creek. Diatoms were also abundant and ranked second to *Hydrurus* at this site. The filamentous green algae *Zygnema* sp. and *Ulothrix zonata* were abundant and frequent here and ranked third and fourth in biovolume, respectively. An increase in dominance by filamentous green alage generally parallels an increase in nutrient concentrations in streams (Wehr and Sheath 2003). The filamentous cyanophyte *Hydrocoleum* ranked fifth in biomass at this site.

Skyland Creek above Bear Creek. *Hydrurus foetidus* and diatoms were co-dominants at this site and ranked first and second, respectively, in terms of biomass. The filamentous green alga *Ulothrix zonata*, which was abundant, was the only other non-diatom species present at this site (Table 3).

Diatoms (Table 4)

The four major diatom species from Sullivan Creek and Skyland Creek are included in pollution tolerance classes 3 or 2 and are either sensitive to organic pollution or only somewhat tolerant of organic pollution (Table 4). None of the major diatom species are most tolerant of organic pollution (pollution tolerance class = 1).

Sullivan Creek above Connor Creek. A very high value for the percent dominant species (*Hannaea arcus*) and low values for the number of species counted and the diversity index indicate moderate to severe stress at this site (Table 4). Since *Hannaea arcus* is a cold stenothermal diatom and an attached pioneer species that is sensitive to organic pollution, its dominance here is probably related to steep gradients, fast currents, cold temperatures, and/or low nutrient concentrations. *Hannaea arcus* is one of the most common diatom species in glacier- and snowmelt-fed streams of the Swiss Alps (Hieber et al. 2001). A high value for the pollution index and zero values for the siltation index and percent abnormal cells indicate that organic enrichment, sedimentation, and toxic metals did not affect the association of benthic

diatoms at this site and that the stresses recorded here are probably natural in origin. The only other major diatom species at this site—*Achnanthidium minutissimum*—is also an attached pioneer species that is sensitive to organic loading.

Sullivan Creek below Quintonkon Creek. Although the equitability and diversity of diatom species improved at this site compared to the upstream site, diatom species richness remained low and still indicated moderate stress from natural causes. However, a significant decline in the pollution index occurred between the upstream site and this site (Table 4), which indicated a significant increase in organic loading. Although organic loading increased, the pollution index at this site remained above the threshold for minor impairment. However, the dominant diatom species here (*Fragilaria vaucheriae*) is somewhat tolerant of organic loading and the large percentage of this species indicated minor impairment here.

A few teratological cells of *Fragilaria vaucheriae* and *Hannaea arcus* were also counted at this site. Abnormal diatom cells sometimes indicate elevated concentrations of heavy metals (McFarland et al. 1997). However, there are many other possible causes of abnormal diatom cells, including natural factors such as rapid population growth and crowding, silica depletion, low water temperatures, and low pH. The araphid diatoms, which include *F. vaucheriae* and *H. arcus*, seem to be especially prone to producing teratological cells (McFarland et al. 1997). Given that populations of *F. vaucheriae* and *H. arcus* were very large and probably expanding at the time, and given the austere environmental conditions prevailing at this site, the minor stress indicated by a few abnormal cells in Sullivan Creek is likely natural in origin and not related to heavy metals. The two sites on Sullivan Creek shared 43% of their diatom associations, which indicates somewhat similar floras and minor environmental change.

Skyland Creek above Bear Creek. The dominant diatom at this site was *Encyonema silesiacum*, which is somewhat tolerant of organic pollution. A large percentage of this species indicated moderate impairment here (Table 4). The pollution index also indicated minor impairment from organic loading. Diatom species richness, equitability, and diversity were also low and indicated minor impairment. Two abnormal cells of *Hannaea arcus* were observed during the diatom proportional count, again probably the result of natural causes.

Modal Categories (Table 5)

Several ecological attributes assigned by Stevenson and Van Dam et al. (1994) were selected from the diatom reports in the appendix and modal categories of these attributes were extracted to characterize water quality tendencies in Sullivan and Skyland Creeks (Table 5).

The majority of diatoms at both sites on Sullivan Creek were non-motile autotrophs that tolerate high concentrations of organics and indicate alkaline and fresh-brackish waters with continuously high dissolved oxygen. However, the percentage of diatoms in the “continuously high” category declined significantly from the upstream site to the downstream site, indicating a decline in the availability of dissolved oxygen. The modal categories for saprobity and trophic state each shifted two levels between the upstream and downstream sites, indicating significant increases in organic loading and concentrations of inorganic nutrients.

In Skyland Creek, the modal category for oxygen demand was “moderate”, indicating even less available dissolved oxygen here than in lower Sullivan Creek. The modal category for saprobity in Skyland Creek was alpha-mesosaprobous, which is the same modal category that was recorded at the lower site on Sullivan Creek (Table 5). The alpha-mesosaprobous category indicates waters with 25-70% oxygen saturation and 4-13 mg/L BOD (Van Dam et al. 1994).

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Red Meadow Creek






Mainstem Red Meadow Creek

Site Visit Form

Place Site Visit Label Here — 03-0931

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-C06.
Trip ID: 2003-FLTHD Date: 8/27/03
Personnel: Laidlaw / Pridmore

Waterbody Name: Red Meadow Creek County: Flathead HUC: 17010206
Station ID: C06RDMEC01 Visit #: ____ Location: At Mouth
Lat: 48.80707 Long: 114.34727 Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0931M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 1:45 / 13:45	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: 10 min Kick Length (Ft.): 150'

Site Visit Comments: upstream of bridge - some armoring nr bridge
cobble / small boulder
still recovering from Red Bench fire - veg regrowing in riparian area
very dominated by riffles
some fine sediment in depositional areas - minimal amts.

Flathead National Forest Documents

Substrate DEQ/MDM

am Name Red Meadow X-sect Station ID #RM 1 Date 8 July 03

Site Visit Code Personnel lyp cl Kw gg jd

Particle Category		Size Category (mm)	Pebble Count: Dot and Dash Count ∴ =3, ⊠ =10 (UL)	(CS)		(LL)	Sum	% of Total	Cum. Total
Silt/Clay		< 1							
Sand		1-2							
Very Fine		2-4							
Fine		4-6							
Fine		6-8							
Medium		8-12							
Medium		12-16							
Coarse		16-22							
Coarse		22-32							
Very Coarse	Gravels	32-45							
Very Coarse	Gravels	45-64							
Small	Cobbles	64-90							
Small	Cobbles	90-128							
Large	Cobbles	128-180							
Large	Cobbles	180-256							
Small	Boulders	256-362							
Small	Boulders	362-512							
Medium	Boulders	512-1024							
Large	Boulders	1024-2048							
Bedrock	Boulders	>2048							
Total # of Samples			100						

FOR INFORMATION

FLATHEAD NATIONAL FOREST

STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

9 July 03

ITEM RATED RM X-section	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright.	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright, +/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	8							

Add the values in each column for a total reach score here. (E. 8 + G. 50 +F. 15 +P. 0 = 73)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
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Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
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Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	12		34					

Add the values in each column for a total reach score here. (E. 12 + G. 34 +F. 30 +P. 0 = 76)

64 76

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

Red Meadow Creek Lower Limit

7/9/03 J. Grace K. Weikel, D. Pridmore, C. Lewis J. DeKalb

FLATHEAD NATIONAL FOREST

STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

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	EXCELLENT		GOOD		FAIR		POOR	
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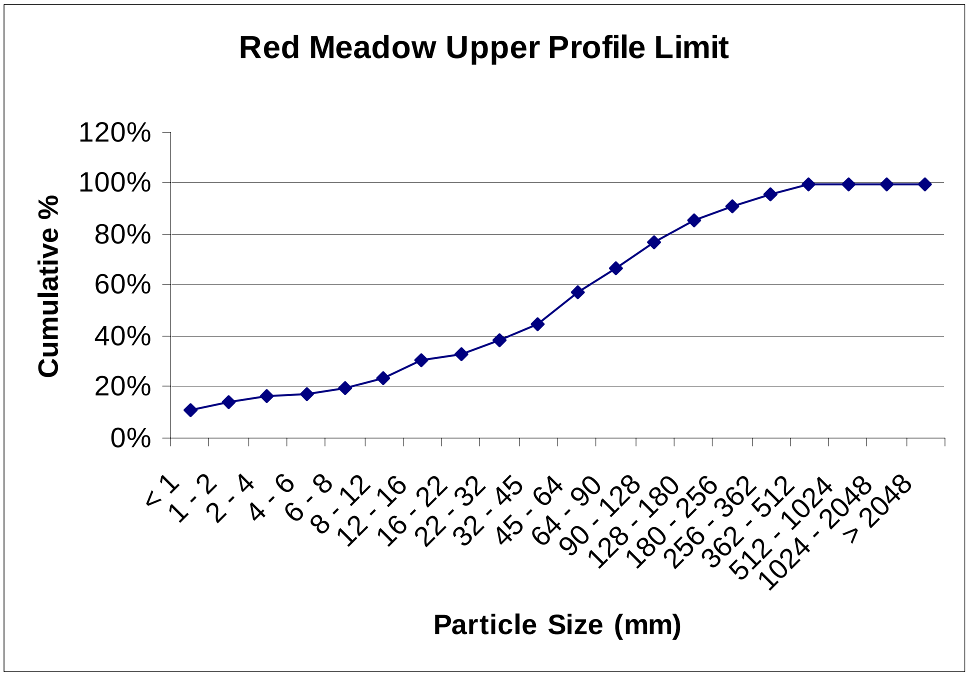
COLUMN TOTALS	6							

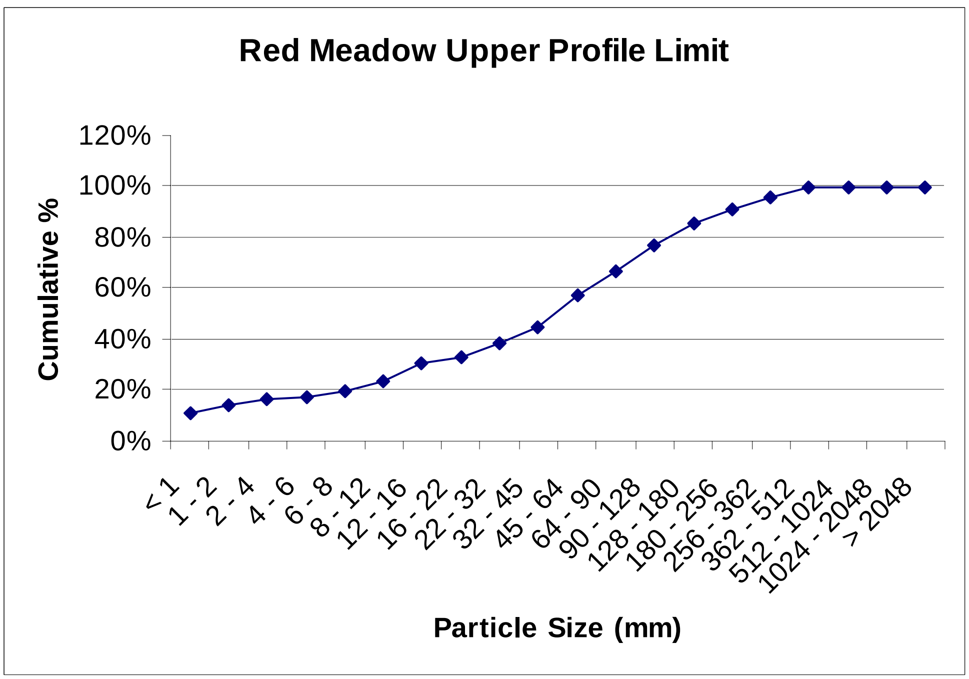
Add the values in each column for a total reach score here. (E. 6 + G. 56 +F. 12 +P. 0 = 74)

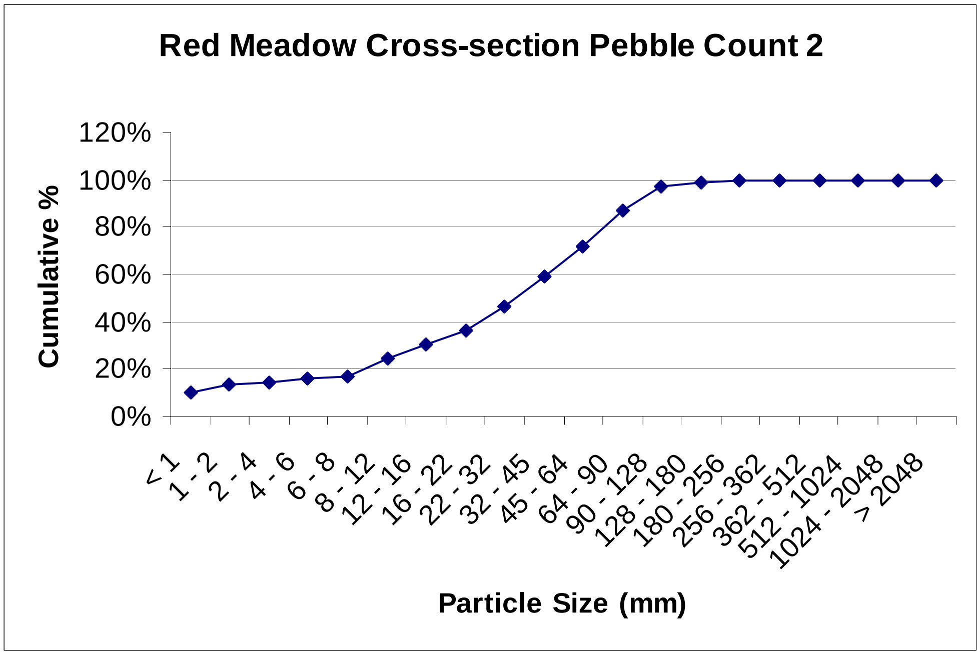
Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

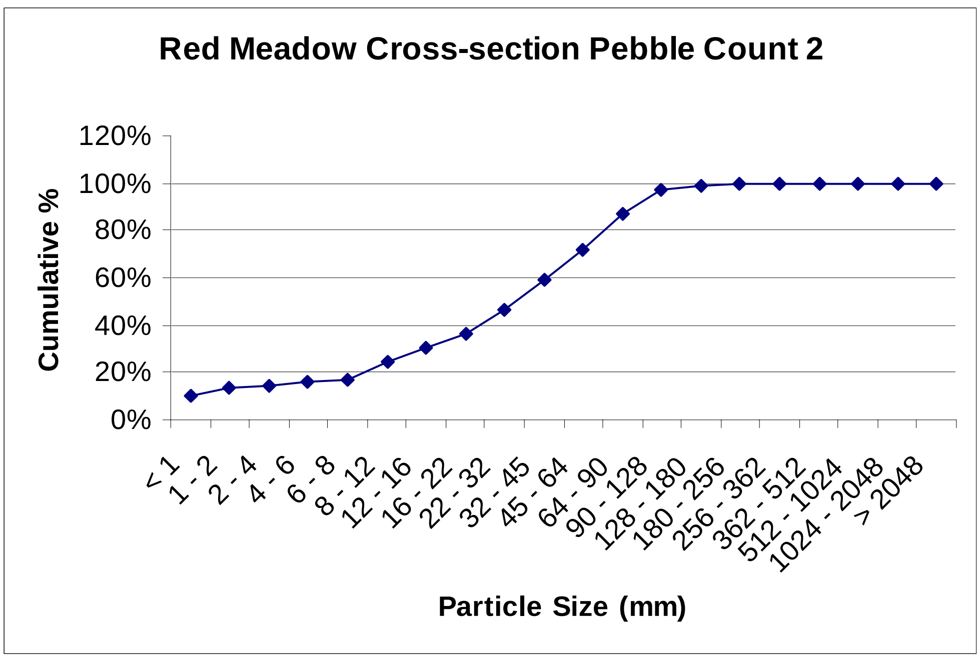
FOR INFORMATION

Pebble Counts






Red Meadow Cross-section Pebble Count 2
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)


Red Meadow Cross-section Pebble Count 2
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)

SUBSTRATE DEQ/MDM								
Date: 8-Jul-03				**Site Visit Code:**Red Meadow Upper Profile Limit				
Waterbody: Main-stem Red Meadow				**STORET Station ID:**				
Personnel: djp,cl,kw,jg,jd								
PEBBLE COUNT								
Row ID	**Particle Category**		**Size (mm)**	**Riffle Count**	**(Other) Count**	***Characteristic Group: PEBL-CNT***		
				100.00%	**0.00%**	**Sum**	**% of Total**	**Cum. Total**
1	**Silt / Clay**		**< 1**	**11**		**11**	11.22%	11.22%
2	**Sand**		**1 - 2**	**3**		**3**	3.06%	14.29%
3	**Very Fine**	**GRAVELS**	**2 - 4**	**2**		**2**	2.04%	16.33%
4	**Fine**		**4 - 6**	**1**		**1**	1.02%	17.35%
5	**Fine**		**6 - 8**	**2**		**2**	2.04%	19.39%
6	**Medium**		**8 - 12**	**4**		**4**	4.08%	23.47%
7	**Medium**		**12 - 16**	**7**		**7**	7.14%	30.61%
8	**Coarse**		**16 - 22**	**2**		**2**	2.04%	32.65%
9	**Coarse**		**22 - 32**	**6**		**6**	6.12%	38.78%
10	**Very Coarse**		**32 - 45**	**6**		**6**	6.12%	44.90%
11	**Very Coarse**		**45 - 64**	**12**		**12**	12.24%	57.14%
12	**Small**	**COBBLES**	**64 - 90**	**9**		**9**	9.18%	66.33%
13	**Small**		**90 - 128**	**10**		**10**	10.20%	76.53%
14	**Large**		**128 - 180**	**9**		**9**	9.18%	85.71%
15	**Large**		**180 - 256**	**5**		**5**	5.10%	90.82%
16	**Small**	**BOULDERS**	**256 - 362**	**5**		**5**	5.10%	95.92%
17	**Small**		**362 - 512**	**4**		**4**	4.08%	100.00%
18	**Medium**		**512 - 1024**	**0**		**0**	0.00%	100.00%
19	**Large**		**1024 - 2048**	**0**		**0**	0.00%	100.00%
20	**Bedrock**		**> 2048**	**0**		**0**	0.00%	100.00%
21	**Total # Samples**			**98**	**0**	**98**	**100.00%**	

SUBSTRATE DEQ/MDM

Date: 8-Jul-03 **Site Visit Code:** RedMead X-section 1

Waterbody: mainstem Red Meadow **STORET Station ID:**

Personnel: djp,cl,kw,jg,jd

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	11		11	9.32%	9.32%
2	Sand		1 - 2	4		4	3.39%	12.71%
3	Very Fine	GRAVELS	2 - 4	0		0	0.00%	12.71%
4	Fine	GRAVELS	4 - 6	1		1	0.85%	13.56%
5	Fine	GRAVELS	6 - 8	2		2	1.69%	15.25%
6	Medium	GRAVELS	8 - 12	7		7	5.93%	21.19%
7	Medium	GRAVELS	12 - 16	9		9	7.63%	28.81%
8	Coarse	GRAVELS	16 - 22	3		3	2.54%	31.36%
9	Coarse	GRAVELS	22 - 32	14		14	11.86%	43.22%
10	Very Coarse	GRAVELS	32 - 45	16		16	13.56%	56.78%
11	Very Coarse	GRAVELS	45 - 64	18		18	15.25%	72.03%
12	Small	COBBLES	64 - 90	18		18	15.25%	87.29%
13	Small	COBBLES	90 - 128	11		11	9.32%	96.61%
14	Large	COBBLES	128 - 180	3		3	2.54%	99.15%
15	Large	COBBLES	180 - 256	0		0	0.00%	99.15%
16	Small	BOULDERS	256 - 362	1		1	0.85%	100.00%
17	Small	BOULDERS	362 - 512	0		0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024	0		0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048	0		0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048	0		0	0.00%	100.00%
21	Total # Samples			118	0	118	100.00%	

SUBSTRATE DEQ/MDM

Date: 8-Jul-03 **Site Visit Code:** Red Meadow X-section 2

Waterbody: mainstem Red Meadow **STORET Station ID:**

Personnel: djp,cl,kw,jg,jd

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	12		12	10.53%	10.53%
2	Sand		1 - 2	3		3	2.63%	13.16%
3	Very Fine	GRAVELS	2 - 4	1		1	0.88%	14.04%
4	Fine	GRAVELS	4 - 6	2		2	1.75%	15.79%
5	Fine	GRAVELS	6 - 8	1		1	0.88%	16.67%
6	Medium	GRAVELS	8 - 12	9		9	7.89%	24.56%
7	Medium	GRAVELS	12 - 16	7		7	6.14%	30.70%
8	Coarse	GRAVELS	16 - 22	6		6	5.26%	35.96%
9	Coarse	GRAVELS	22 - 32	12		12	10.53%	46.49%
10	Very Coarse	GRAVELS	32 - 45	14		14	12.28%	58.77%
11	Very Coarse	GRAVELS	45 - 64	15		15	13.16%	71.93%
12	Small	COBBLES	64 - 90	17		17	14.91%	86.84%
13	Small	COBBLES	90 - 128	12		12	10.53%	97.37%
14	Large	COBBLES	128 - 180	2		2	1.75%	99.12%
15	Large	COBBLES	180 - 256	1		1	0.88%	100.00%
16	Small	BOULDERS	256 - 362	0		0	0.00%	100.00%
17	Small	BOULDERS	362 - 512	0		0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024	0		0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048	0		0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048	0		0	0.00%	100.00%
21	Total # Samples			114	0	114	100.00%	

Red Meadow Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	3.405-3.415 16-July-1976	3.405-3.415 5-July-1979	2.21 – 4.882 12-Aug-1982	9.33-9.34 16-July-1976	9.33-9.34 5-July-1979	8.78-11.88 9-Aug-1982
Landform slope	2	4	2	4	6	2
Mass wasting (existing or potential)	3	9	7	6	3	6
Debris jam potential (floatable objects)	4	2	6	6	8	8
Vegetative bank protection	3	6	6	6	3	6
LOWER BANKS						
Channel capacity	1	2	3	2	1	2
Bank rock content	6	4	5	2	8	6
Obstructions/flow deflectors/sediment traps	2	2	7	2	4	6
Cutting	8	8	12	4	4	10
Deposition	4	8	12	4	8	14
BOTTOM						
Rock angularity	2	2	3	2	2	3
Brightness	2	1	3	3	2	4
Consolidation or particle packing	4	2	4	4	6	4
Bottom size distribution/ percent stable materials	8	4	12	8	8	14
Scouring and deposition	12	6	18	12	12	18
Clinging aquatic vegetation	2	2	2	3	3	3
TOTALS	**52**	**62**	**102**	**68**	**78**	**106**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Red Meadow Creek Historic Pfankuch Rating Comparison

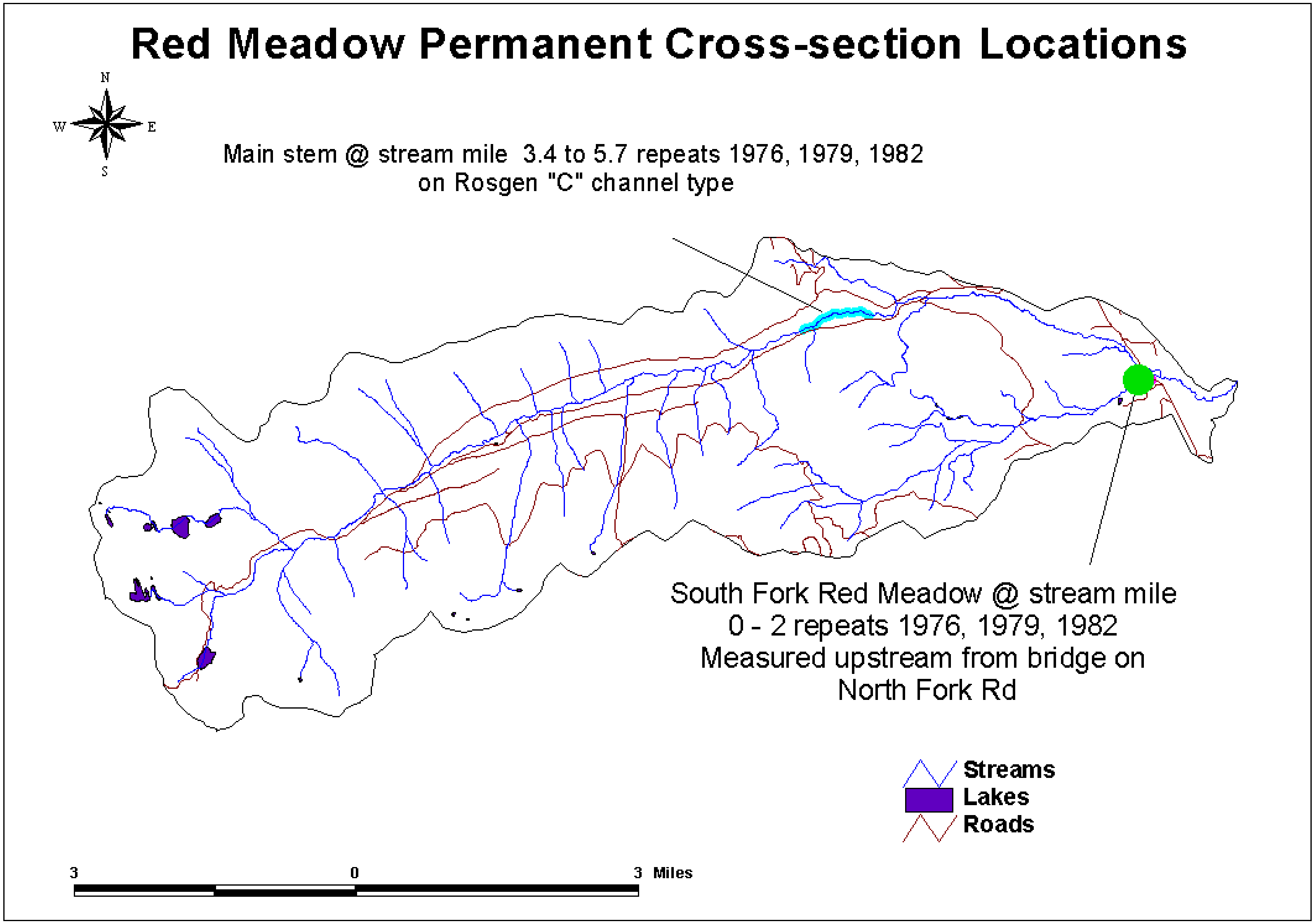
UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	13.508-13.51 16-July-1976	13.508-13.51 5-July-1979	13.13-13.949 9-Aug-1982	Profile UL 9-July-2003	Profile CS 9-July-2003	Profile LL 9-July-2003
Landform slope	6	4	2	2	2	2
Mass wasting (existing or potential)	6	3	3	3	3	6
Debris jam potential (floatable objects)	4	4	6	2	6	6
Vegetative bank protection	7	6	4	2	3	3
LOWER BANKS						
Channel capacity	1	1	1	6	3	3
Bank rock content	2	6	2	4	4	4
Obstructions/flow deflectors/sediment traps	2	4	4	8	4	4
Cutting	4	4	4	8	8	8
Deposition	4	8	4	2	8	8
BOTTOM						
Rock angularity	2	2	1	2	3	2
Brightness	1	1	1	2	2	1
Consolidation or particle packing	2	4	4	8	4	4
Bottom size distribution and percent stable materials	4	4	8	18	8	8
Scouring and deposition	6	12	9	3	12	12

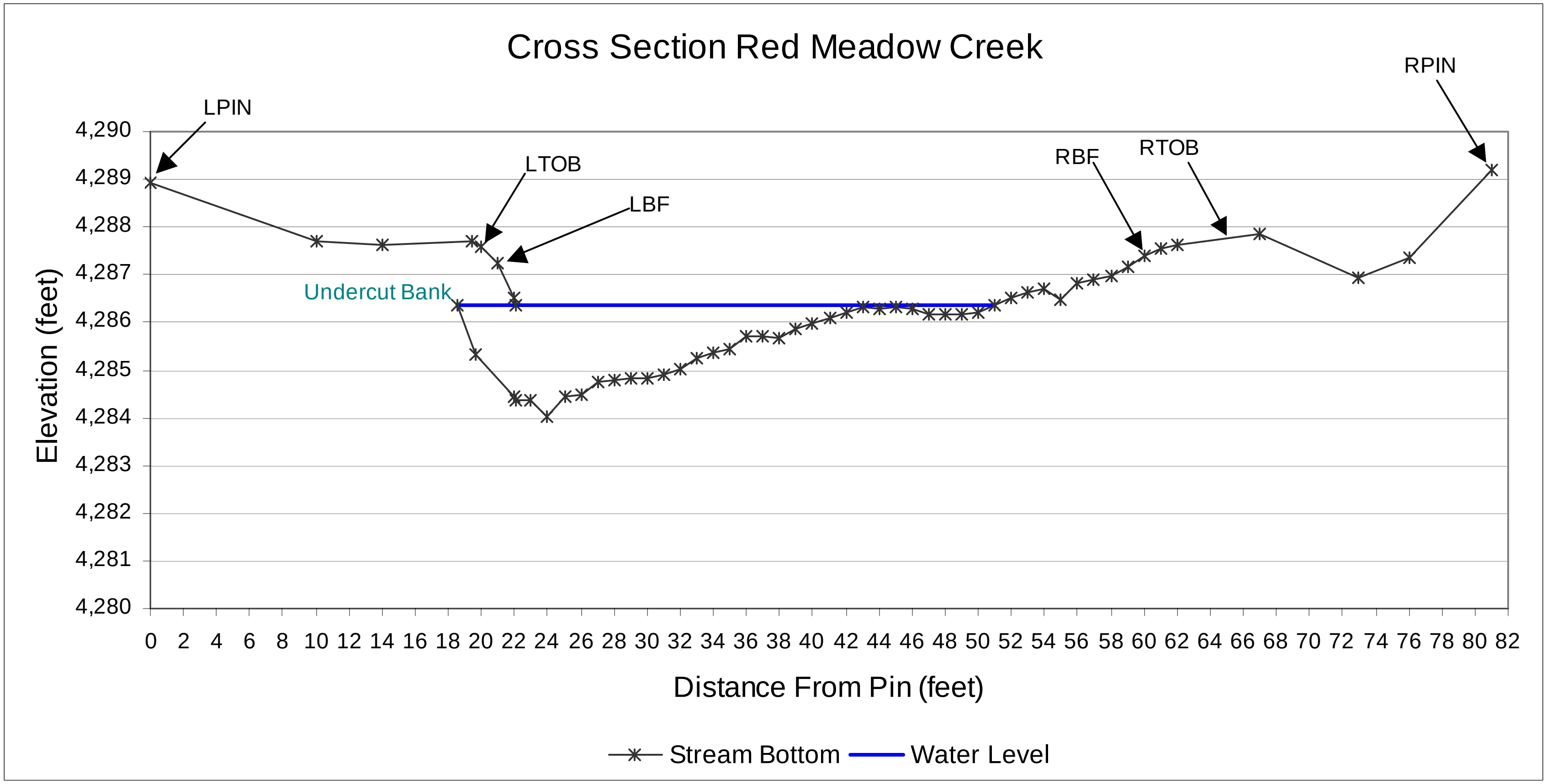
UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	13.508-13.51 16-July-1976	13.508-13.51 5-July-1979	13.13-13.949 9-Aug-1982	Profile UL 9-July-2003	Profile CS 9-July-2003	Profile LL 9-July-2003
Clinging aquatic vegetation	2	2	2	3	3	3
TOTALS	**53**	**65**	**55**	**76**	**73**	**74**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

74.3 Average Pfankuch for 3 ratings done at the lower limit (LL), the cross-section (CS), and the upper limit (UL) of the 1000 foot profile completed as part of the field assessment of Red Meadow current conditions for the FHPA report. Field map displayed below.

Cross-Section



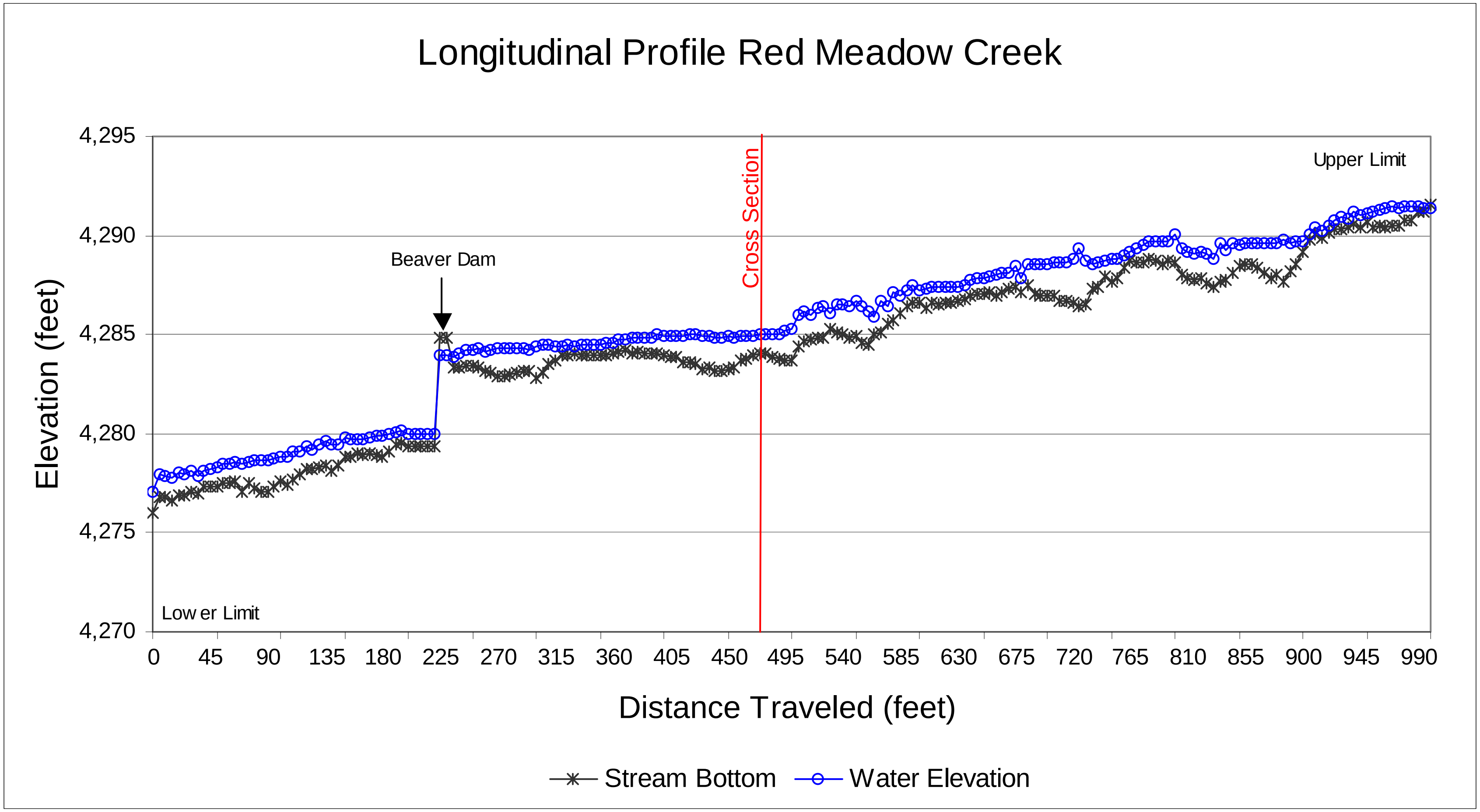


Vertical exaggeration = 12.2

LPIN = left (looking downstream) pin
LTOP = left top of bank
LBF = left bankfull

RBF = right bankfull
RTOB = right top of bank
RPIN = right (looking downstream) pin

Longitudinal Profile



Vertical exaggeration = 2.52

South Fork Red Meadow

Flathead National Forest Documents

Substrate DEQ/MDM

Stream Name Red Meadow South Fork Station ID Lower Limit Date 7/15/03

Site Visit Code Personnel J. Grace, J. DeFolem, C. Zuri, K. Weikel

location in old bridge (~100ft upstream of N. Fork Road)

Pebble Count

Particle Category		Size Category (mm)	Dot and Dash Count ⁚ = 3, ☒ = 10	Sum	% of Total	Cum. Total
Silt/Clay		< 1				
Sand		1-2				
Very Fine		2-4				
Fine		4-6				
Fine		6-8				
Medium		8-12				
Medium		12-16	53 17			
Coarse		16-22	70			
Coarse		22-32	85			
Very Coarse	Gravels	32-45				
Very Coarse	Gravels	45-64				
Small		64-90				
Small		90-128				
Large	Cobbles	128-180				
Large	Cobbles	180-256				
Small		256-362				
Small		362-512				
Medium		512-1024				
Large	Boulders	1024-2048				
Bedrock	Boulders	>2048				
Total # of Samples						

FOR INFORMATION

Red Meadow – South Fork

FLATHEAD NATIONAL FOREST

(… of N. Fork Road)

STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

7/10/03 J. Grad J. DeSalvo C. Lewis R. Weinel

ITEM RATED	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright.	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

Add the values in each column for a total reach score here. (E. 1 + G. 50 +F. 30 +P. 8 = 89)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

S. Red MDW. CK.
upper limit 7/10/03

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright.	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright, +/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

Add the values in each column for a total reach score here. (E. 12 + G. ~~28~~ 34 +F. 18 +P. 12 = 76)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR IN MATION

Red Meadow Creek South Fork
Cross Section 7/10/03

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

J. Grace, K. Weikel, J. DeLorean, C. Lewis

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
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LOWER BANKS								
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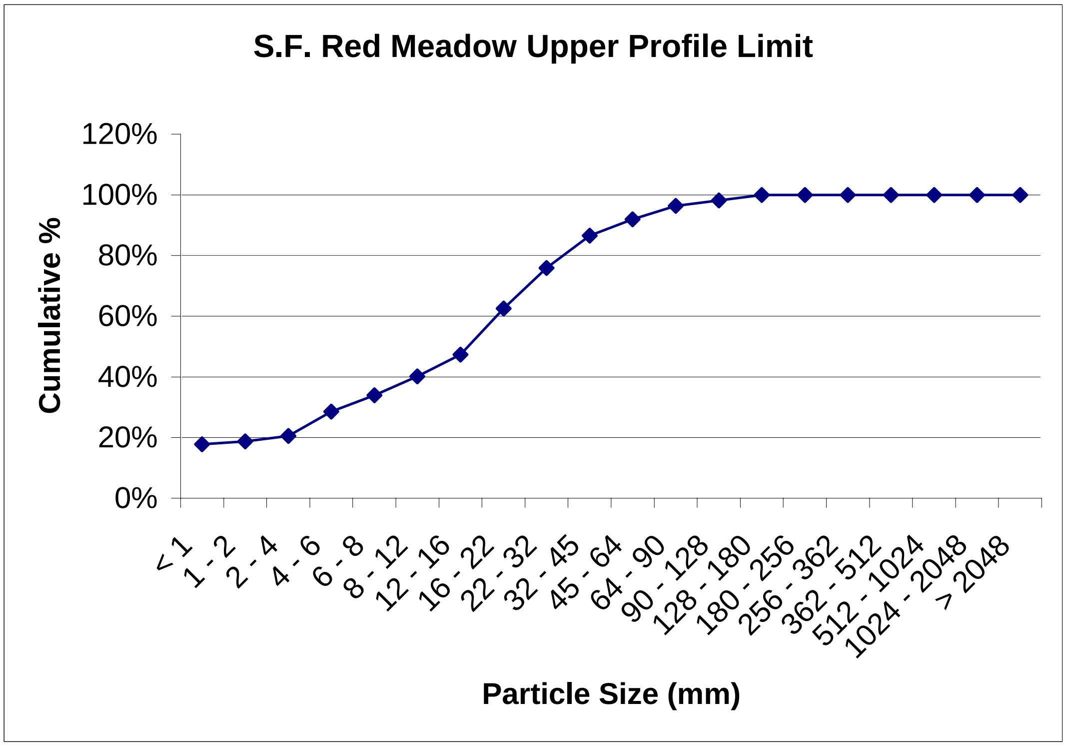
COLUMN TOTALS								

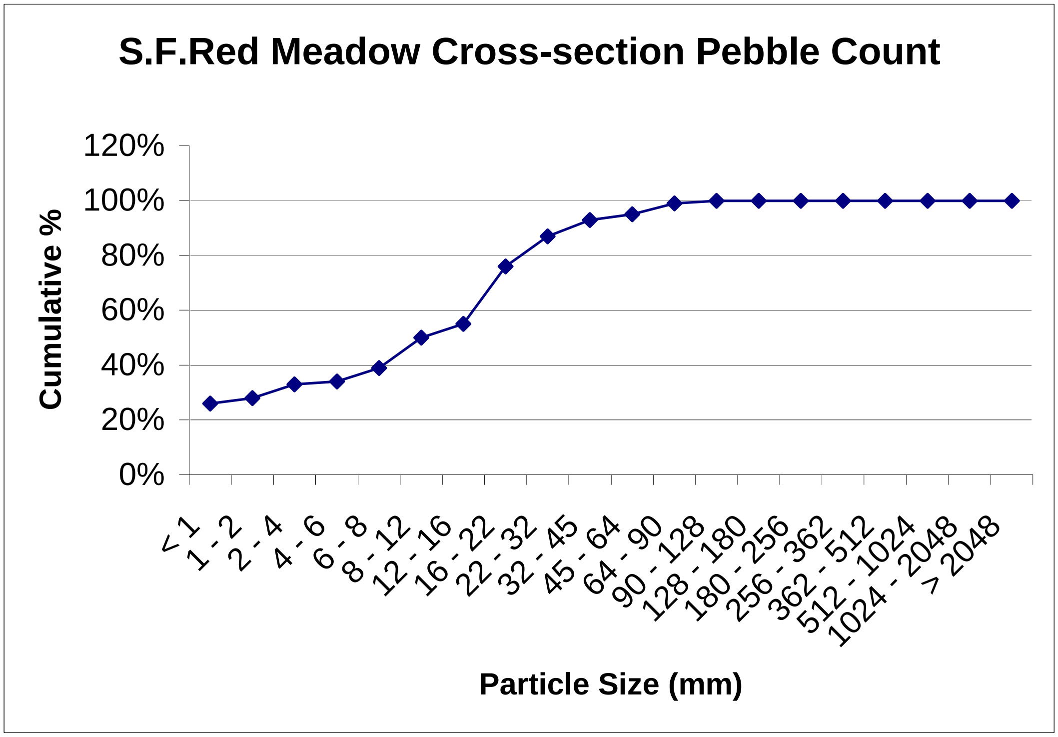
Add the values in each column for a total reach score here. (E. 4 + G. 46 + F. 27 + P. 8 = 85)

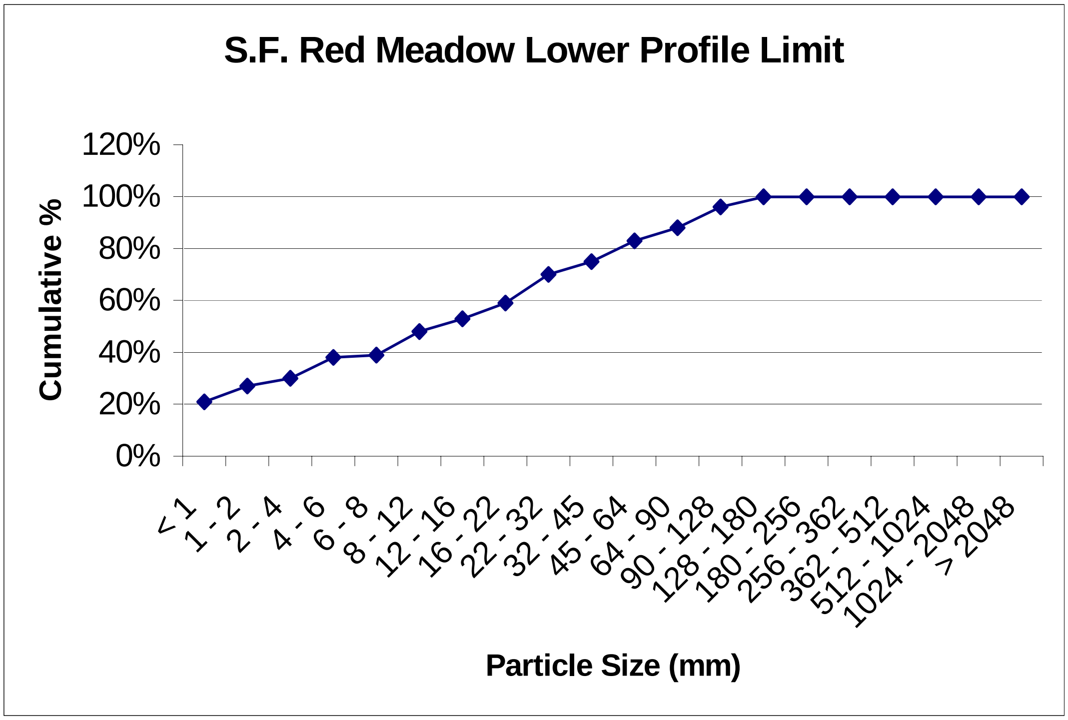
Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR INFORMATION

Pebble Counts






S.F. Red Meadow Lower Profile Limit
120%
100%
80%
60%
40%
20%
0%
Cumulative %
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)

SUBSTRATE DEQ/MDM

Date: 7/10/2003 **Site Visit Code:** SF Red Mead Upper Profile Limit

Waterbody: South Fork Red Meadow **STORET Station ID:**

Personnel: J. Grace, J. DeRaleau, C.Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	20		20	17.86%	17.86%
2	Sand		1 - 2	1		1	0.89%	18.75%
3	Very Fine	GRAVELS	2 - 4	2		2	1.79%	20.54%
4	Fine	GRAVELS	4 - 6	9		9	8.04%	28.57%
5	Fine	GRAVELS	6 - 8	6		6	5.36%	33.93%
6	Medium	GRAVELS	8 - 12	7		7	6.25%	40.18%
7	Medium	GRAVELS	12 - 16	8		8	7.14%	47.32%
8	Coarse	GRAVELS	16 - 22	17		17	15.18%	62.50%
9	Coarse	GRAVELS	22 - 32	15		15	13.39%	75.89%
10	Very Coarse	GRAVELS	32 - 45	12		12	10.71%	86.61%
11	Very Coarse	GRAVELS	45 - 64	6		6	5.36%	91.96%
12	Small	COBBLES	64 - 90	5		5	4.46%	96.43%
13	Small	COBBLES	90 - 128	2		2	1.79%	98.21%
14	Large	COBBLES	128 - 180	2		2	1.79%	100.00%
15	Large	COBBLES	180 - 256			0	0.00%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			112	0	112	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/10/2003 **Site Visit Code:** SF Red Meadow X-section

Waterbody: South Fork Red Meadow **STORET Station ID:**

Personnel: J. Grace, J. DeRaleau, C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	26		26	26.00%	26.00%
2	Sand		1 - 2	2		2	2.00%	28.00%
3	Very Fine	GRAVELS	2 - 4	5		5	5.00%	33.00%
4	Fine	GRAVELS	4 - 6	1		1	1.00%	34.00%
5	Fine	GRAVELS	6 - 8	5		5	5.00%	39.00%
6	Medium	GRAVELS	8 - 12	11		11	11.00%	50.00%
7	Medium	GRAVELS	12 - 16	5		5	5.00%	55.00%
8	Coarse	GRAVELS	16 - 22	21		21	21.00%	76.00%
9	Coarse	GRAVELS	22 - 32	11		11	11.00%	87.00%
10	Very Coarse	GRAVELS	32 - 45	6		6	6.00%	93.00%
11	Very Coarse	GRAVELS	45 - 64	2		2	2.00%	95.00%
12	Small	COBBLES	64 - 90	4		4	4.00%	99.00%
13	Small	COBBLES	90 - 128	1		1	1.00%	100.00%
14	Large	COBBLES	128 - 180			0	0.00%	100.00%
15	Large	COBBLES	180 - 256			0	0.00%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			100	0	100	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/10/2003 **Site Visit Code:** SF Red Meadow Lower profile limit

Waterbody: South Fork Red Meadow **STORET Station ID:**

Personnel: J. Grace, J. DeRaleau, C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	21		21	21.00%	21.00%
2	Sand		1 - 2	6		6	6.00%	27.00%
3	Very Fine	GRAVELS	2 - 4	3		3	3.00%	30.00%
4	Fine	GRAVELS	4 - 6	8		8	8.00%	38.00%
5	Fine	GRAVELS	6 - 8	1		1	1.00%	39.00%
6	Medium	GRAVELS	8 - 12	9		9	9.00%	48.00%
7	Medium	GRAVELS	12 - 16	5		5	5.00%	53.00%
8	Coarse	GRAVELS	16 - 22	6		6	6.00%	59.00%
9	Coarse	GRAVELS	22 - 32	11		11	11.00%	70.00%
10	Very Coarse	GRAVELS	32 - 45	5		5	5.00%	75.00%
11	Very Coarse	GRAVELS	45 - 64	8		8	8.00%	83.00%
12	Small	COBBLES	64 - 90	5		5	5.00%	88.00%
13	Small	COBBLES	90 - 128	8		8	8.00%	96.00%
14	Large	COBBLES	128 - 180	4		4	4.00%	100.00%
15	Large	COBBLES	180 - 256			0	0.00%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			100	0	100	100.00%	

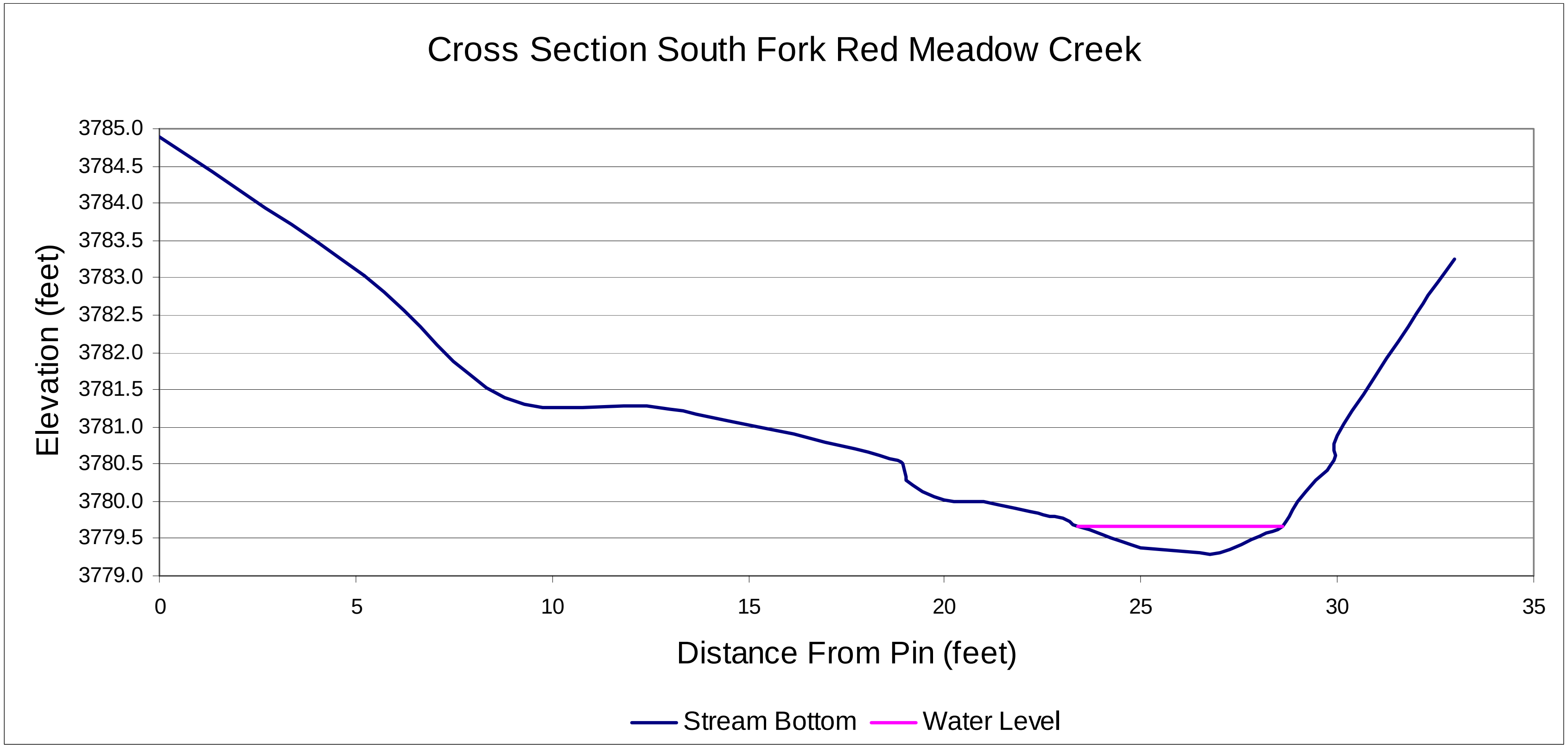
South Fork Red Meadow Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	0.153-0.163 14 July 1976	0.153-0.163 10 July 1979	0.0-2.722 18 Aug.1982	2.722-3.661 18 Aug.1982	Profile UL 10 July 2003	Profile CS 10 July 2003	Profile LL 10 July 2003
Landform slope	2	2	2	6	4	4	4
Mass wasting	6	3	3	3	6	3	6
Debris jam potential	6	2	5	4	8	8	8
Vegetative bank protection	6	3	4	3	3	6	6
LOWER BANKS							
Channel capacity	1	1	3	2	1	2	2
Bank rock content	6	2	6	4	6	6	6
Obstructions/flow deflectors/sediment traps	4	2	6	4	6	4	4
Cutting	8	4	6	4	4	8	12
Deposition	12	4	8	4	4	8	8
BOTTOM							
Rock angularity	2	1	4	2	4	3	2
Brightness	2	1	2	2	3	2	2
Consolidation or particle packing	4	2	3	4	4	6	4
Bottom size distribution/ percent stable materials	8	4	4	4	8	12	12
Scouring and deposition	18	6	12	9	12	12	12
Clinging aquatic vegetate	3	1	2	1	3	1	1
TOTALS	**88**	**38**	**70**	**56**	**76**	**85**	**89**

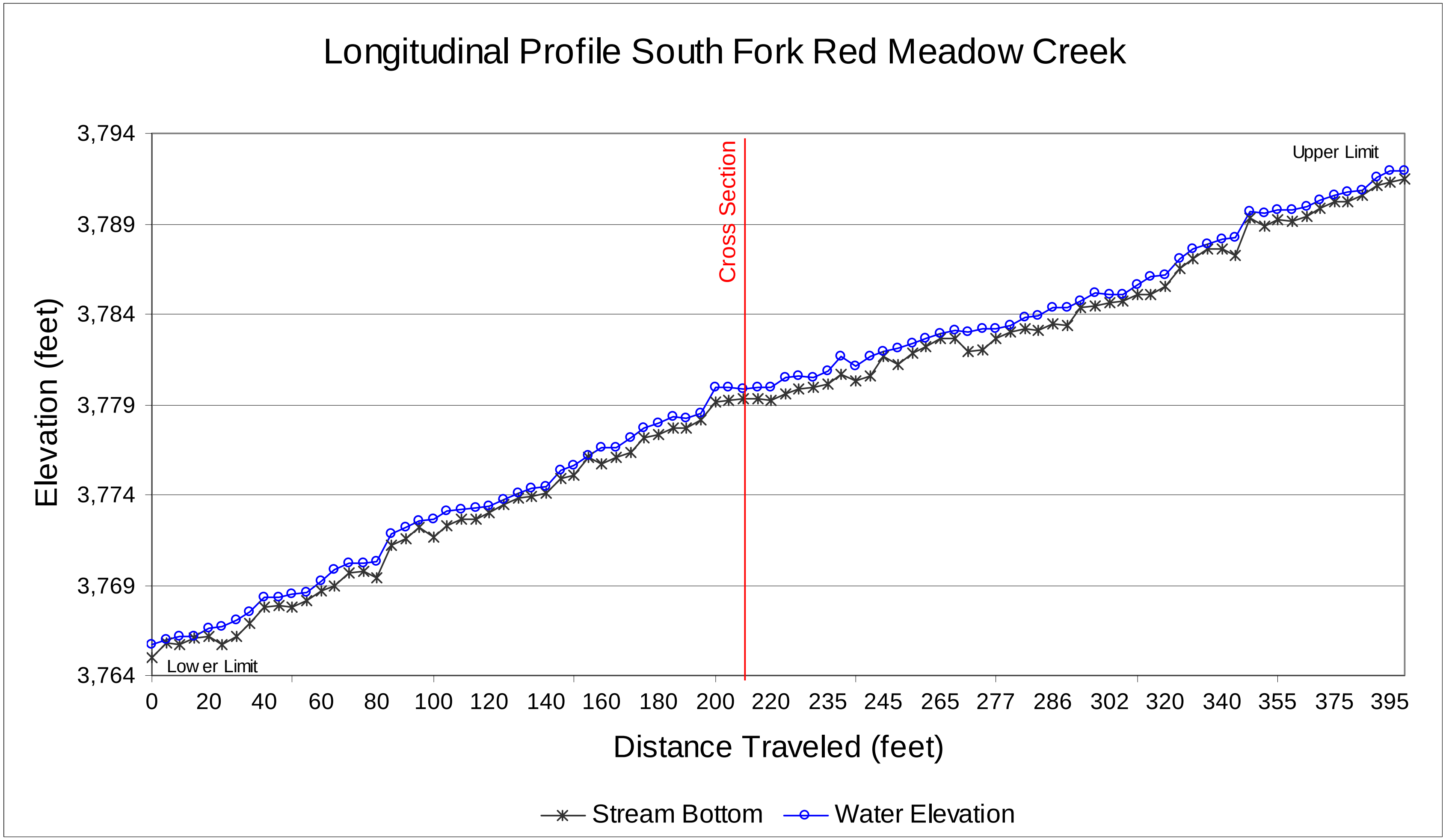
Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

83.3 Average Pfankuch rating for the for 3 ratings done at the lower limit (LL), the cross-section (CS), and the upper limit (UL) of the 400 foot profile completed as part of the field assessment of South Fork Red Meadow current conditions for the FHPA report.

Cross-Section



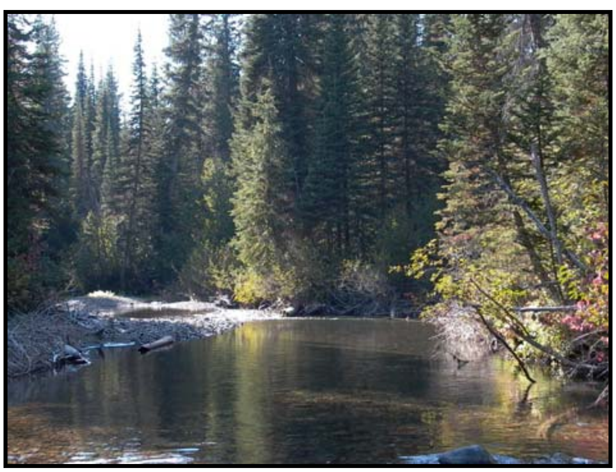
Longitudinal Profile



Whale Creek








Whale Creek Reach 1

Site Visit Form

Place Site Visit Label Here 03-0929

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-Cola
Trip ID: 2003-FLTHD Date: 8/27/03
Personnel: Laidlaw/Pridmore

Waterbody Name Whale Creek County Flathead HUC 17010206
Station ID C06WHALC01 Visit # ____ Location At North Fork Bridge
Lat 48.85146 N Long 114.36242 W Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0929M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 11:10	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		

TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐
Turbidity Comments:

Macroinvertebrate Kick Duration: 100' Kick Length (Ft.): 7 min 30 sec
Site Visit Comments: Elevation = 3683'
Photos of site, sampled upstream of bridge
cobble/boulder dominated
great riparian vegetation, downstream of fire impacts
Some erosion near bridge, mid-channel point bar
lots of blackflies

Flathead National Forest Documents

Whale Creek (Lower Limit 1)
7-17-03
(GPS-ID: WLL-1)

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

K. Wikel

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	5		~~48~~ 60					

FOR INFORMATION

Add the values in each column for a total reach score here. (E. 5 + G. 60 +F. 9 +P. 0 = 74)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

Whale Creek
Upper Limit
(GPS-ID: WUL-1)

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

K. Wikel

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright.	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	5		46		30		0	

FOR INFORMATION

Add the values in each column for a total reach score here. (E. 5 + G. 46 +F. 30 +P. 0 = 81)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

Whale Creek
cross-section 7/14/03
(GPS - ID: WCS-1)

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

K. Wi...

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
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Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
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Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
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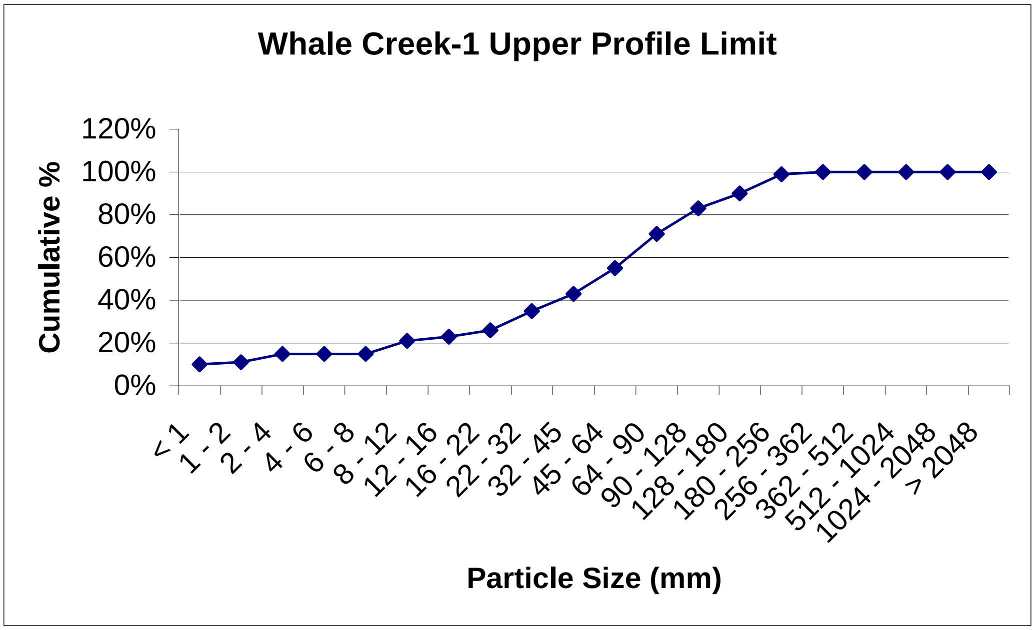
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	5		44		36		0	

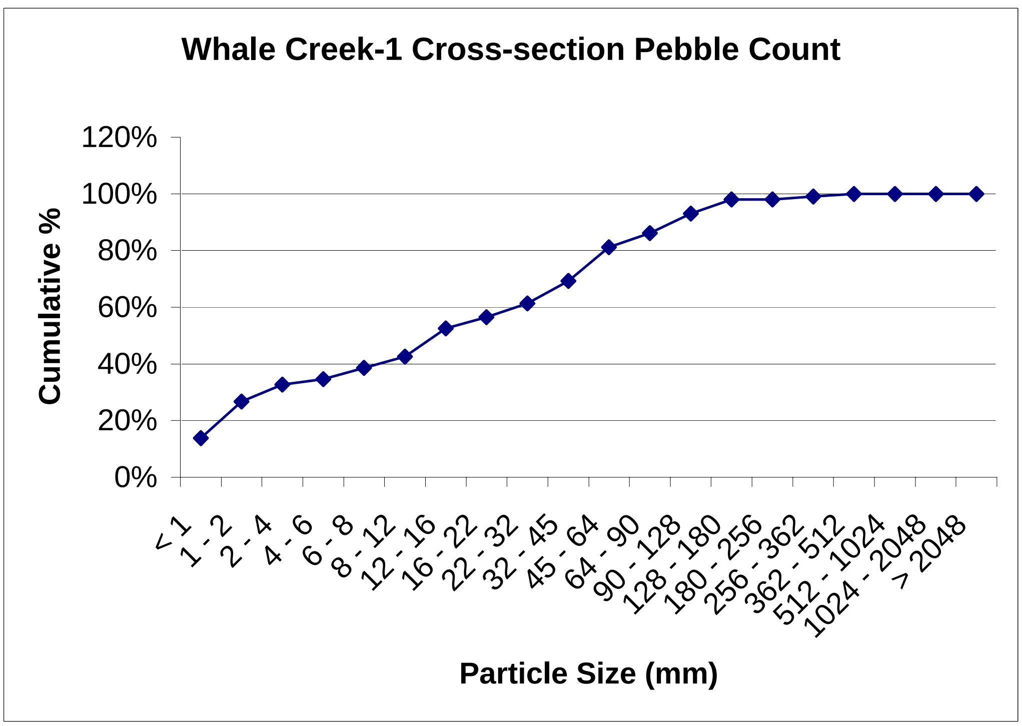
Add the values in each column for a total reach score here. (E. 5 + G. 44 +F. 36 +P. 0 = 85)

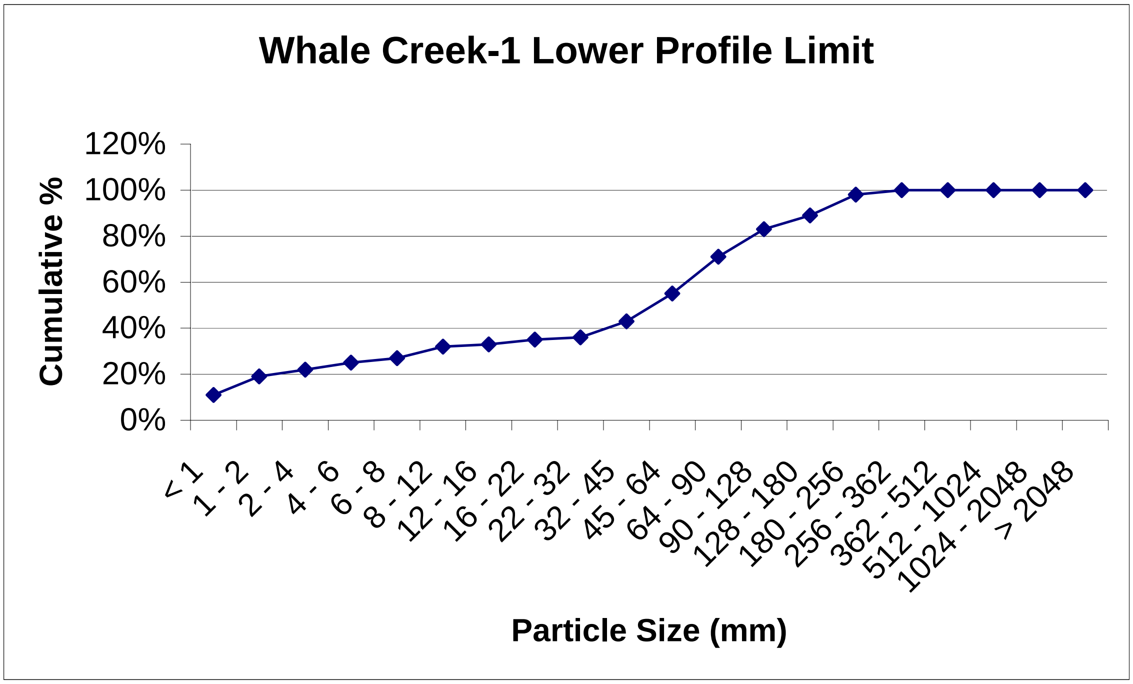
Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

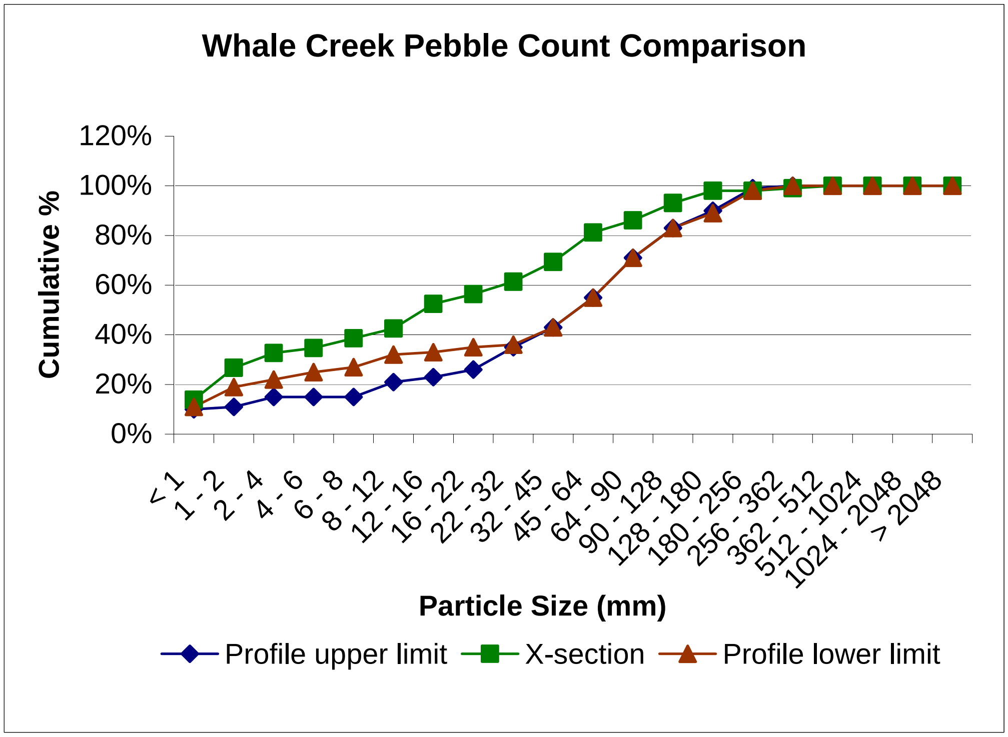
FOR INFORMATION

Pebble Counts






Whale Creek-1 Lower Profile Limit
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)


Whale Creek Pebble Count Comparison
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Profile upper limit
X-section
Profile lower limit

SUBSTRATE DEQ/MDM

Date: 7/14/2003 **Site Visit Code:** Whale Ck-1 Profile Upper Limit

Waterbody: Whale Creek **STORET Station ID:**

Personnel: C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	10		10	10.00%	10.00%
2	Sand		1 - 2	1		1	1.00%	11.00%
3	Very Fine	GRAVELS	2 - 4	4		4	4.00%	15.00%
4	Fine	GRAVELS	4 - 6			0	0.00%	15.00%
5	Fine	GRAVELS	6 - 8			0	0.00%	15.00%
6	Medium	GRAVELS	8 - 12	6		6	6.00%	21.00%
7	Medium	GRAVELS	12 - 16	2		2	2.00%	23.00%
8	Coarse	GRAVELS	16 - 22	3		3	3.00%	26.00%
9	Coarse	GRAVELS	22 - 32	9		9	9.00%	35.00%
10	Very Coarse	GRAVELS	32 - 45	8		8	8.00%	43.00%
11	Very Coarse	GRAVELS	45 - 64	12		12	12.00%	55.00%
12	Small	COBBLES	64 - 90	16		16	16.00%	71.00%
13	Small	COBBLES	90 - 128	12		12	12.00%	83.00%
14	Large	COBBLES	128 - 180	7		7	7.00%	90.00%
15	Large	COBBLES	180 - 256	9		9	9.00%	99.00%
16	Small	BOULDERS	256 - 362	1		1	1.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			100	0	100	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/14/2003 **Site Visit Code:** Whale Creek-1 Cross-section

Waterbody: Whale Creek **STORET Station ID:**

Personnel: C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	14		14	13.86%	13.86%
2	Sand		1 - 2	13		13	12.87%	26.73%
3	Very Fine	GRAVELS	2 - 4	6		6	5.94%	32.67%
4	Fine	GRAVELS	4 - 6	2		2	1.98%	34.65%
5	Fine	GRAVELS	6 - 8	4		4	3.96%	38.61%
6	Medium	GRAVELS	8 - 12	4		4	3.96%	42.57%
7	Medium	GRAVELS	12 - 16	10		10	9.90%	52.48%
8	Coarse	GRAVELS	16 - 22	4		4	3.96%	56.44%
9	Coarse	GRAVELS	22 - 32	5		5	4.95%	61.39%
10	Very Coarse	GRAVELS	32 - 45	8		8	7.92%	69.31%
11	Very Coarse	GRAVELS	45 - 64	12		12	11.88%	81.19%
12	Small	COBBLES	64 - 90	5		5	4.95%	86.14%
13	Small	COBBLES	90 - 128	7		7	6.93%	93.07%
14	Large	COBBLES	128 - 180	5		5	4.95%	98.02%
15	Large	COBBLES	180 - 256			0	0.00%	98.02%
16	Small	BOULDERS	256 - 362	1		1	0.99%	99.01%
17	Small	BOULDERS	362 - 512	1		1	0.99%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			101	0	101	100.00%	

SUBSTRATE DEQ/MDM								
Date: 7/14/2003			**Site Visit Code:** Whale Ck-1. Profile Lower Limit					
Waterbody: Whale Creek				**STORET Station ID:**				
Personnel: C. Lewis, K. Wikel								
PEBBLE COUNT								
Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	11		11	11.00%	11.00%
2	Sand		1 - 2	8		8	8.00%	19.00%
3	Very Fine	GRAVELS	2 - 4	3		3	3.00%	22.00%
4	Fine	GRAVELS	4 - 6	3		3	3.00%	25.00%
5	Fine	GRAVELS	6 - 8	2		2	2.00%	27.00%
6	Medium	GRAVELS	8 - 12	5		5	5.00%	32.00%
7	Medium	GRAVELS	12 - 16	1		1	1.00%	33.00%
8	Coarse	GRAVELS	16 - 22	2		2	2.00%	35.00%
9	Coarse	GRAVELS	22 - 32	1		1	1.00%	36.00%
10	Very Coarse	GRAVELS	32 - 45	7		7	7.00%	43.00%
11	Very Coarse	GRAVELS	45 - 64	12		12	12.00%	55.00%
12	Small	COBBLES	64 - 90	16		16	16.00%	71.00%
13	Small	COBBLES	90 - 128	12		12	12.00%	83.00%
14	Large	COBBLES	128 - 180	6		6	6.00%	89.00%
15	Large	COBBLES	180 - 256	9		9	9.00%	98.00%
16	Small	BOULDERS	256 - 362	2		2	2.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			100	0	100	100.00%	

Whale Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**	**Str.seg. Date**
	8.83-8.84 July-1976	12.12-12.13 July-1976	8.83-8.84 July-1979	12.12-12.13 July-1979	6.98-7.00 Sept.1994	Profile 1 UL 17 July 03	Profile 1 CS 17 July 03	Profile 1 LL 17 July 03
Landform slope	2	2	3	4	6	2	2	2
Mass wasting	3	3	3	3	12	6	6	6
Debris jam potential	8	5	8	4	6	6	6	6
Vegetat bank protection	6	5	6	3	6	3	3	3
LOWER BANKS								
Channel capacity	2	2	1	1	2	3	3	2
Bank rock content	7	5	6	4	6	6	6	4
Obstructions/ flow deflectors/sed iment traps	7	3	4	2	4	4	4	4
Cutting	8	4	8	4	12	8	8	8
Deposition	12	4	8	8	8	12	12	8
BOTTOM								
Rock angularity	3	2	2	2	2	2	3	2
Brightness	3	2	1	1	3	2	2	2
Consolid/ particle pack	5	4	2	2	2	4	4	4

UPPER BANKS	Str.seg. Date	Str.seg. Date	Str.seg. Date	Str.seg. Date	Str.seg. Date	Str.seg. Date	Str.seg. Date	Str.seg. Date
	8.83-8.84 July-1976	12.12-12.13 July-1976	8.83-8.84 July-1979	12.12-12.13 July-1979	6.98-7.00 Sept.1994	Profile 1 UL 17 July 03	Profile 1 CS 17 July 03	Profile 1 LL 17 July 03
Bottom size distribution /percent stable materials	12	8	4	4	8	8	8	8
Scouring and deposition	18	12	6	6	12	12	12	12
Clinging aquatic vegetat	3	2	2	2	2	3	3	3
TOTALS	**99**	**52**	**63**	**50**	**91**	**81**	**85**	**74**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

80 Average Pfankuch for 3 ratings done at the lower limit (LL), the cross-section (CS), and the upper limit (UL) of the 1000 foot profile completed as part of the field assessment of Whale Creek current conditions for the FHPA report. Field map displayed below.

Whale Creek Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	Str.seg. Date	Str.seg. Date	Str.seg. Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date
	Profile 2 UL 22 Sept.03	Profile 2 CS 22 Sept.03	Profile 2 LL 22 Sept.03	Hornet Cr. 0.21-0.22 28 July 1976	Shorty Cr. 0.29-0.3 28 July 1976	Shorty Cr. 1.19-1.2 28 July 1976	Shorty Cr. 3.90-3.91 28 July 1976	Shorty Cr. 01.19-1.2 12 July 1979	Shorty Cr. 3.90-3.91 12 July 1979
Landform slope	6	4	6	5	2	2	4	6	6
Mass wasting	6	6	6	6	3	3	6	6	3

UPPER BANKS	Str.seg. Date	Str.seg. Date	Str.seg. Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date
	Profile 2 UL 22 Sept.03	Profile 2 CS 22 Sept.03	Profile 2 LL 22 Sept.03	Hornet Cr. 0.21-0.22 28 July 1976	Shorty Cr. 0.29-0.3 28 July 1976	Shorty Cr. 1.19-1.2 28 July 1976	Shorty Cr. 3.90-3.91 28 July 1976	Shorty Cr. 01.19-1.2 12 July 1979	Shorty Cr. 3.90-3.91 12 July 1979
Debris jam potential	6	6	6	6	6	7	6	4	4
Vegetat bank protection	3	3	3	3	6	6	6	6	6
LOWER BANKS									
Channel capacity	1	2	1	1	2	2	2	2	1
Bank rock content	6	4	8	2	2	6	2	6	4
Obstructions/flow deflectors/sediment traps	4	4	4	6	6	4	4	2	2
Cutting	8	8	4	6	4	4	4	4	8
Deposition	4	8	4	4	5	8	4	8	4
BOTTOM									
Rock angularity	2	2	2	2	2	2	2	2	2
Brightness	3	3	2	2	2	2	2	1	1
Consolid or particle pack	4	4	2	4	4	4	2	2	2
Bottom size distribution / percent stable materials	12	8	4	8	8	8	8	4	4
Scouring and deposition	18	12	6	12	12	12	12	6	6
Clinging aquatic vegetat	3	2	2	3	3	2	2	2	2
TOTALS	**75**	**65**	**60**	**70**	**67**	**72**	**66**	**61**	**55**

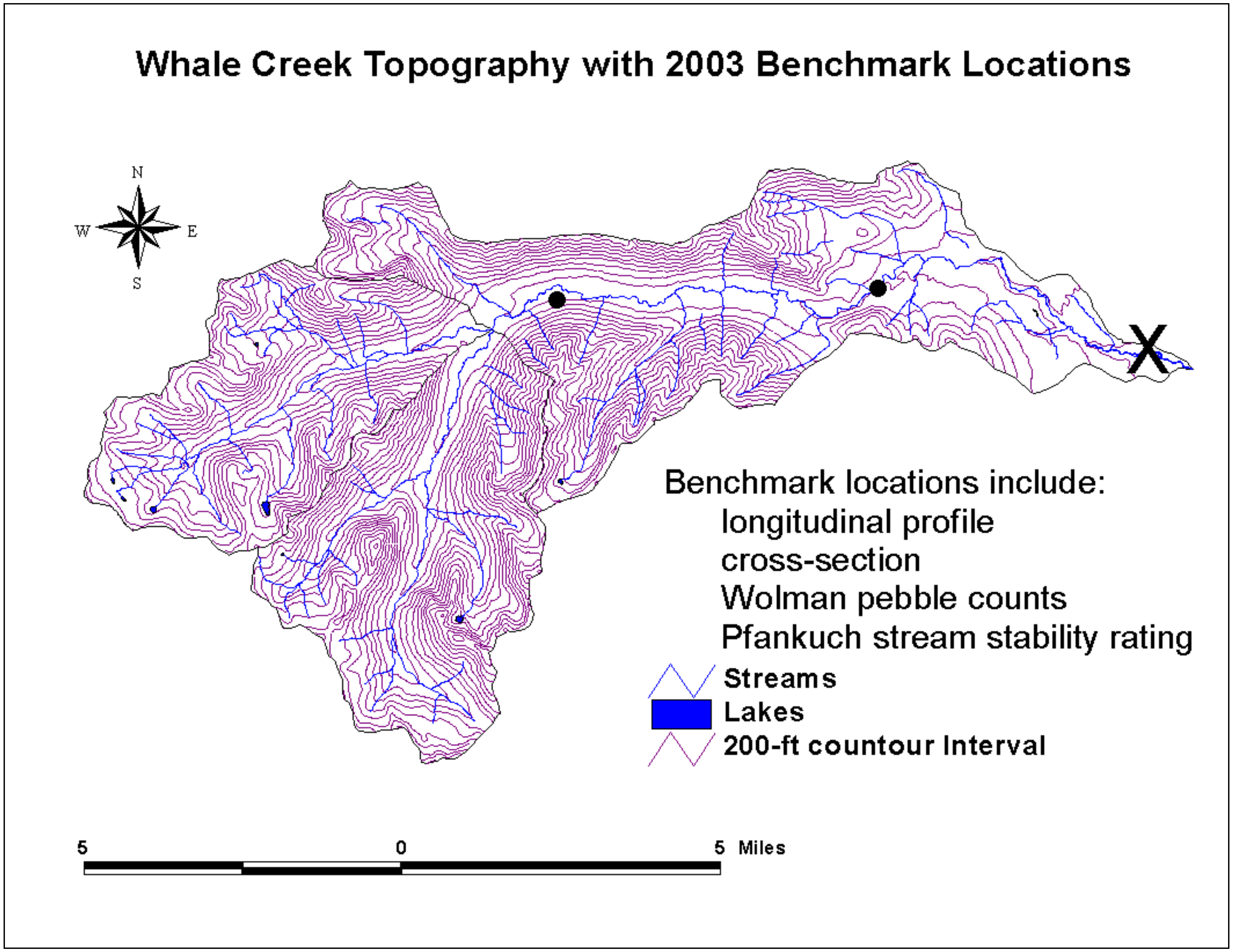
Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Whale Creek Tributary Historic Pfankuch Rating Comparison

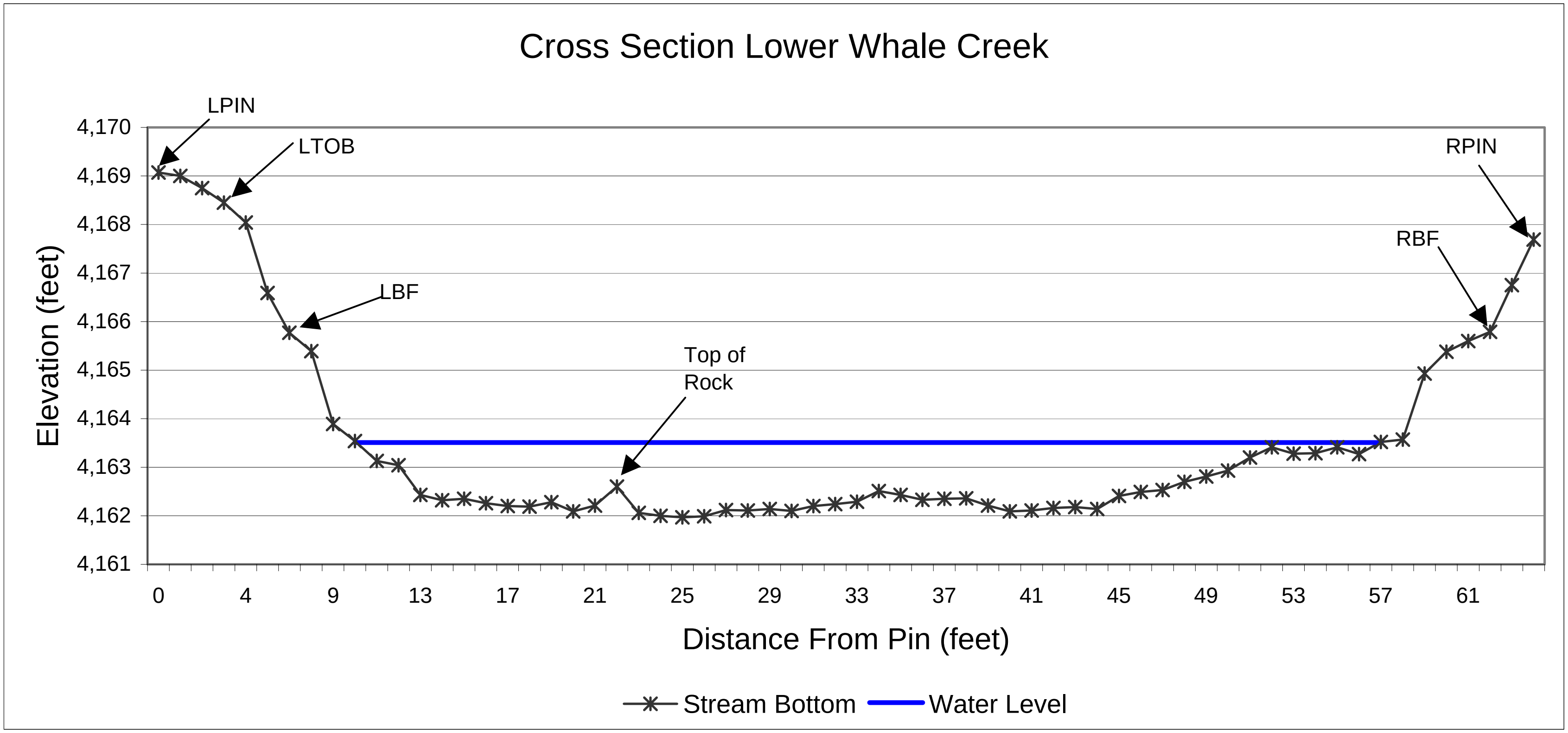
UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Ninko Cr. 0.58-.059 28 July 1976	Ninko Cr 0.59-0.59 10 July 1979	Koopee Cr. 0.107-0.117 28 July 1976	Koopee Cr. 0.107-0.117 10 July 1979	Inuya Cr. 0.155-0.165 28 July 19	Inuya Cr. 0.155-0.165 9 July 1979
Landform slope	4	2	4	6	2	6
Mass wasting	6	3	9	3	6	3
Debris jam potential	7	4	8	8	6	2
Vegetative bank protection	6	6	3	12	9	3
LOWER BANKS						
Channel capacity	1	1	1	2	1	2
Bank rock content	2	4	4	4	4	4
Obstructions/flow deflectors/sediment traps	4	4	4	2	4	2
Cutting	8	4	16	8	12	4
Deposition	4	16	16	4	4	4
BOTTOM						
Rock angularity	2	2	3	2	2	2
Brightness	3	4	4	1	3	2
Consolid or particle packing	6	6	6	4	6	4
Bottom size distribution / percent stable materials	12	8	8	8	8	8
Scouring and deposition	12	24	24	12	18	6
Clinging aquatic vegetation	3	4	4	3	4	3
TOTALS	**80**	**92**	**114**	**79**	**89**	**55**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Whale Creek Cross-Section Locations



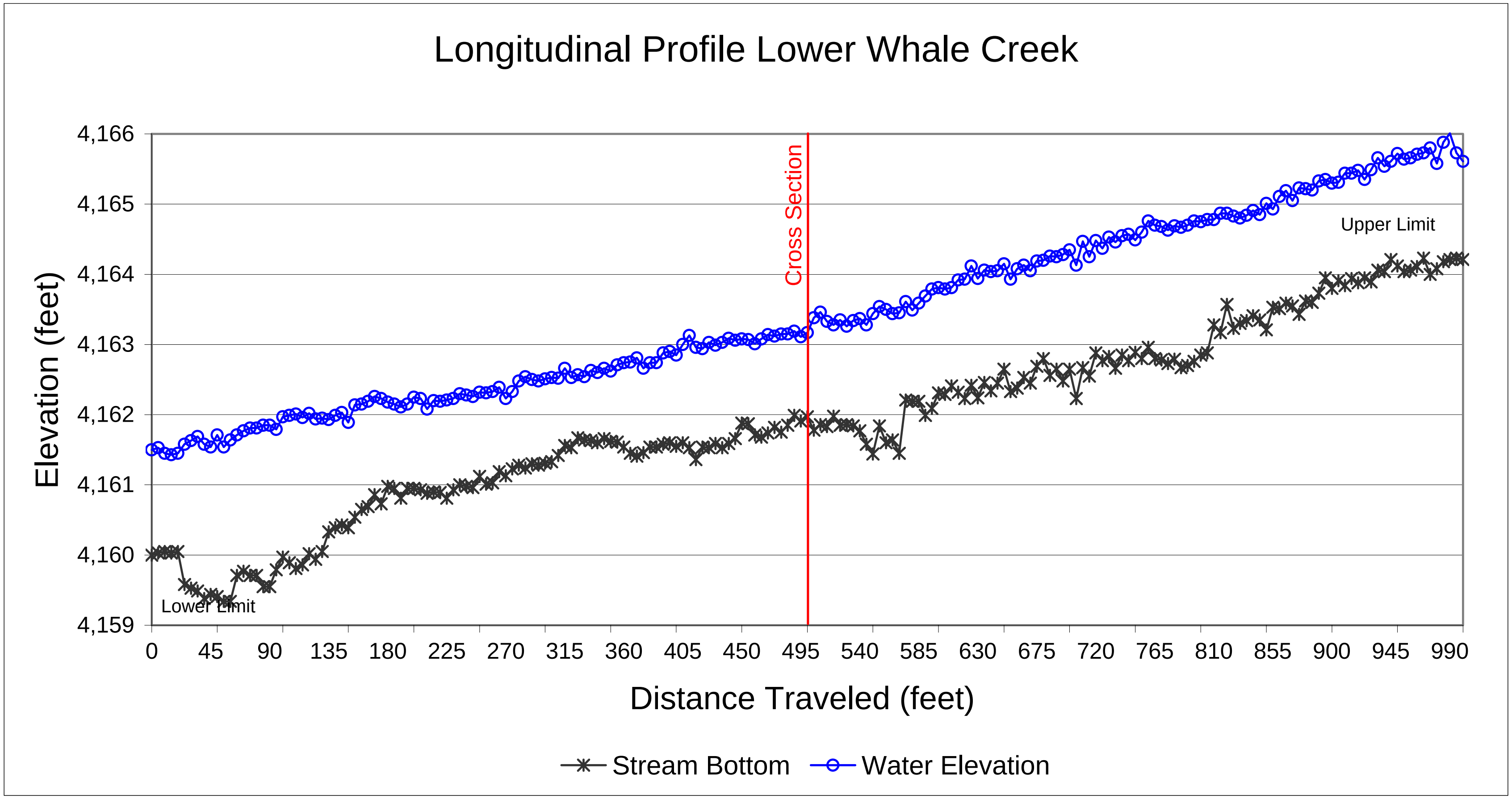
Cross Section



Vertical exaggeration = 13.8
LPIN = left (looking downstream) pin
LTOP = left top of bank
LBF = left bankfull

RBF = right bankfull
RTOB = right top of bank
RPIN = right (looking downstream) pin

Longitudinal Profile



Vertical exaggeration = 10

Whale Creek Reach 2

Site Visit Form

Place Site Visit Label Here 03-0930

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-Cob.

Trip ID: 2003-FLTHD Date: 8/27/03

Personnel: Laidlaw / Pridmore

Waterbody Name Whale Creek County Flathead HUC 17010206

Station ID C06WHALC02 Visit # ____ Location Upper Site

Lat 48.85988 N Long 114.54779 W Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0930M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 12:30	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: 7 min Kick Length (Ft.): 50'

Site Visit Comments:

Upstream of fire riffle run section
upstream of old bridge
great vegetation - mixed ages solid, very extensive
some harvest upstream of site
downstream of confluence w/ Shorty
no bank erosion, no embeddedness, Mostly small cobble
near permanent cross-section

Flathead National Forest Documents

Substrate DEQ/MDM

S Name Whale Creek Station ID WCS-2 Date 7-17-03

Site Visit Code Personnel C. Lewis Ko Wikel

Particle Category		Size Category (mm)	Pebble Count: WCCS2	Dot and Dash Count ∴ = 3, ⊠ = 10: WCC2	WCC2	Sum	% of Total	Cum. Total
Silt/Clay		< 1						
Sand		1-2						
Very Fine	Gravels	2-4						
Fine	Gravels	4-6						
Fine	Gravels	6-8						
Medium	Gravels	8-12						
Medium	Gravels	12-16						
Coarse	Gravels	16-22						
oarse	Gravels	22-32						
Very Coarse	Gravels	32-45						
Very Coarse	Gravels	45-64						
Small	Cobbles	64-90						
Small	Cobbles	90-128						
Large	Cobbles	128-180						
Large	Cobbles	180-256						
Small	Boulders	256-362						
Small	Boulders	362-512						
Medium	Boulders	512-1024						
Large	Boulders	1024-2048						
Bedrock	Boulders	>2048						
Total # of Samples								

FOR INFORMATION

Whale Creek (cross-section) #6
7- 3
(GPS-1 "WCS-2)

K. Wiley

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY D CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

FOR INFORMATION

Add the values in each column for a total reach score here. (E.____ + G.____ +F.____ +P.____ = ____)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

WUL-2
9 ... 93

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

Add the values in each column for a total reach score here. (E.____ + G.____ +F.____ +P.____ = ____)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR INFORMATION

WLL2
9-7

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

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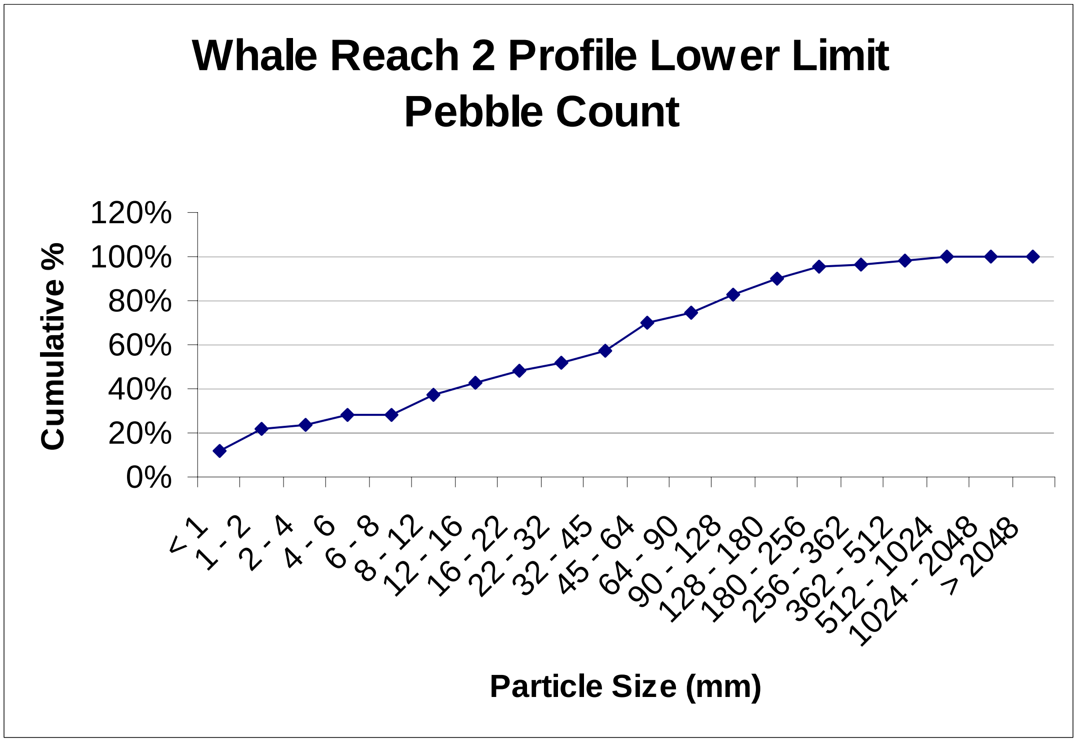
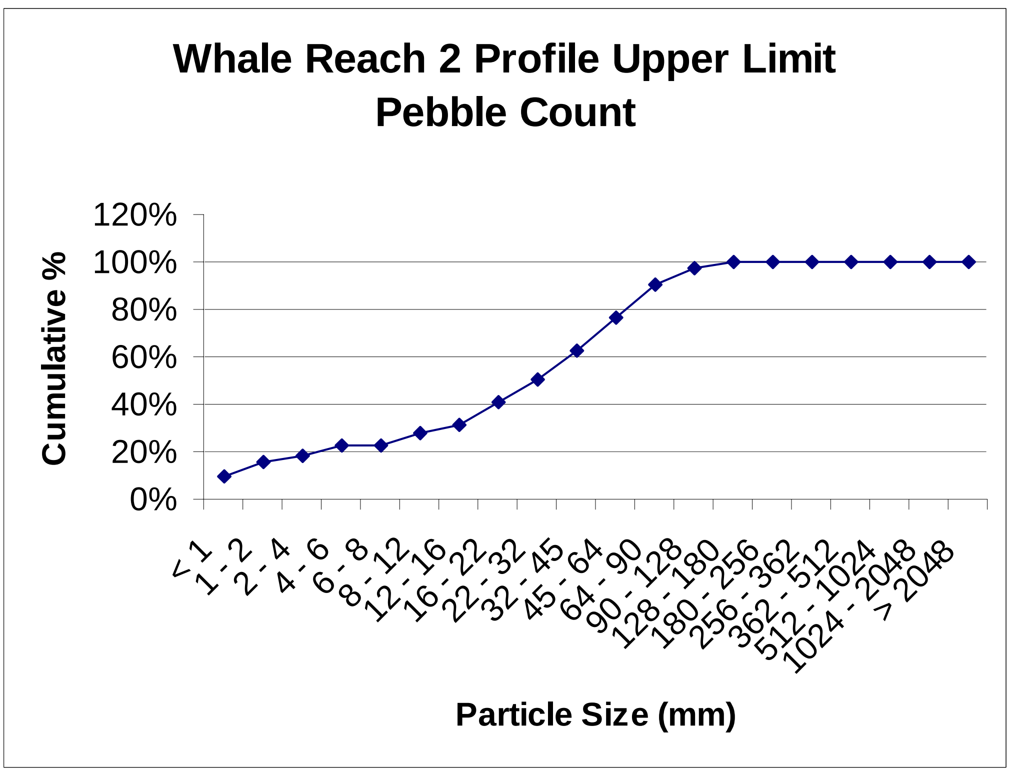
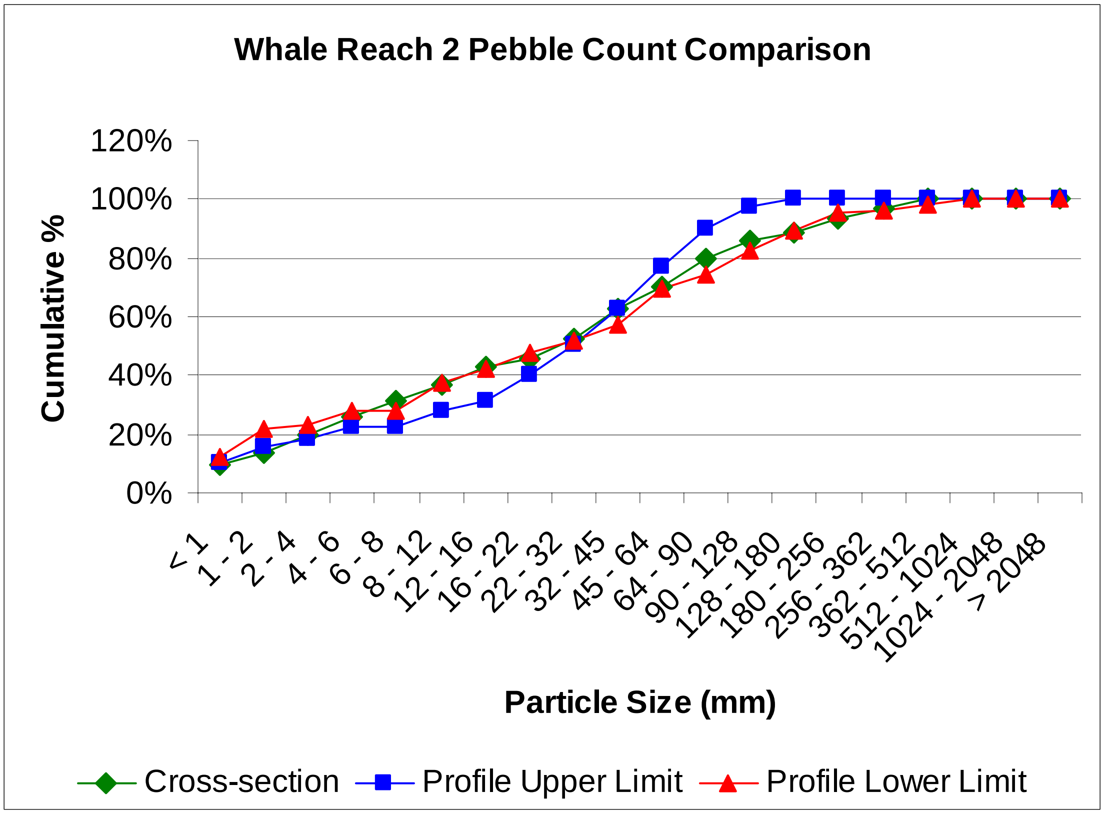
FOR
FORMATION

Pebble Counts






Whale Reach 2 Pebble Count Comparison
120%
100%
80%
60%
40%
20%
0%
Cumulative %
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Cross-section
Profile Upper Limit
Profile Lower Limit

SUBSTRATE DEQ/MDM

Date: 22 Sept.03

Site Visit Code: Profile 2 lower limit

STORET Station ID:

Waterbody: Whale - Upper reach 2

Personnel: CL JG

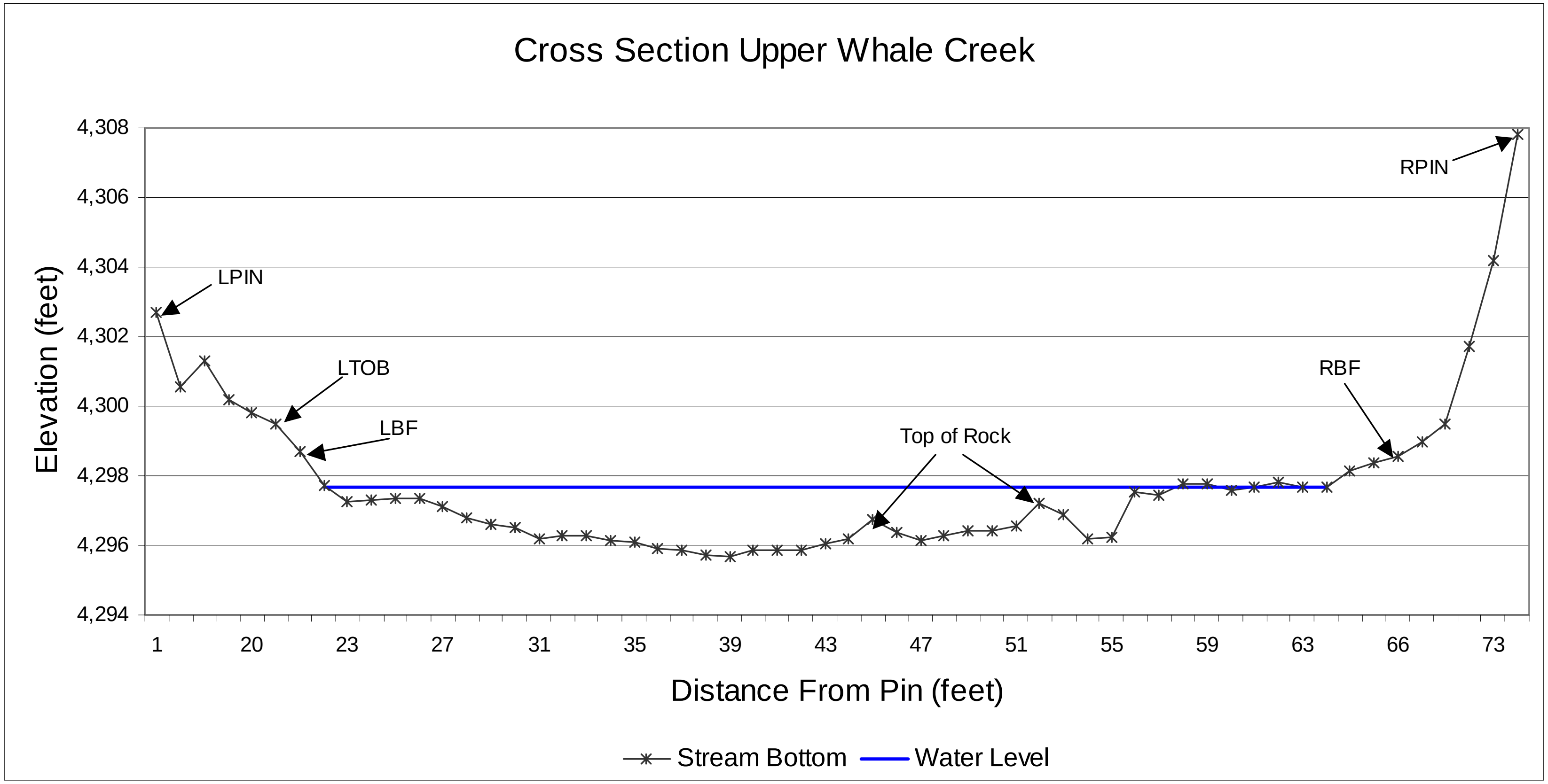
PEBBLE COUNT								
Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	15		15	12.00%	12.00%
2	Sand		1 - 2	12		12	9.60%	21.60%
3	Very Fine	GRAVELS	2 - 4	2		2	1.60%	23.20%
4	Fine		4 - 6	6		6	4.80%	28.00%
5	Fine		6 - 8	0		0	0.00%	28.00%
6	Medium		8 - 12	12		12	9.60%	37.60%
7	Medium		12 - 16	6		6	4.80%	42.40%
8	Coarse		16 - 22	7		7	5.60%	48.00%
9	Coarse		22 - 32	5		5	4.00%	52.00%
10	Very Coarse		32 - 45	7		7	5.60%	57.60%
11	Very Coarse		45 - 64	15		15	12.00%	69.60%
12	Small	COBBLES	64 - 90	6		6	4.80%	74.40%
13	Small		90 - 128	10		10	8.00%	82.40%
14	Large		128 - 180	9		9	7.20%	89.60%
15	Large		180 - 256	7		7	5.60%	95.20%
16	Small	BOULDERS	256 - 362	1		1	0.80%	96.00%
17	Small		362 - 512	3		3	2.40%	98.40%
18	Medium		512 - 1024	2		2	1.60%	100.00%
19	Large		1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			125	0	125	100.00%	

SUBSTRATE DEQ/MDM

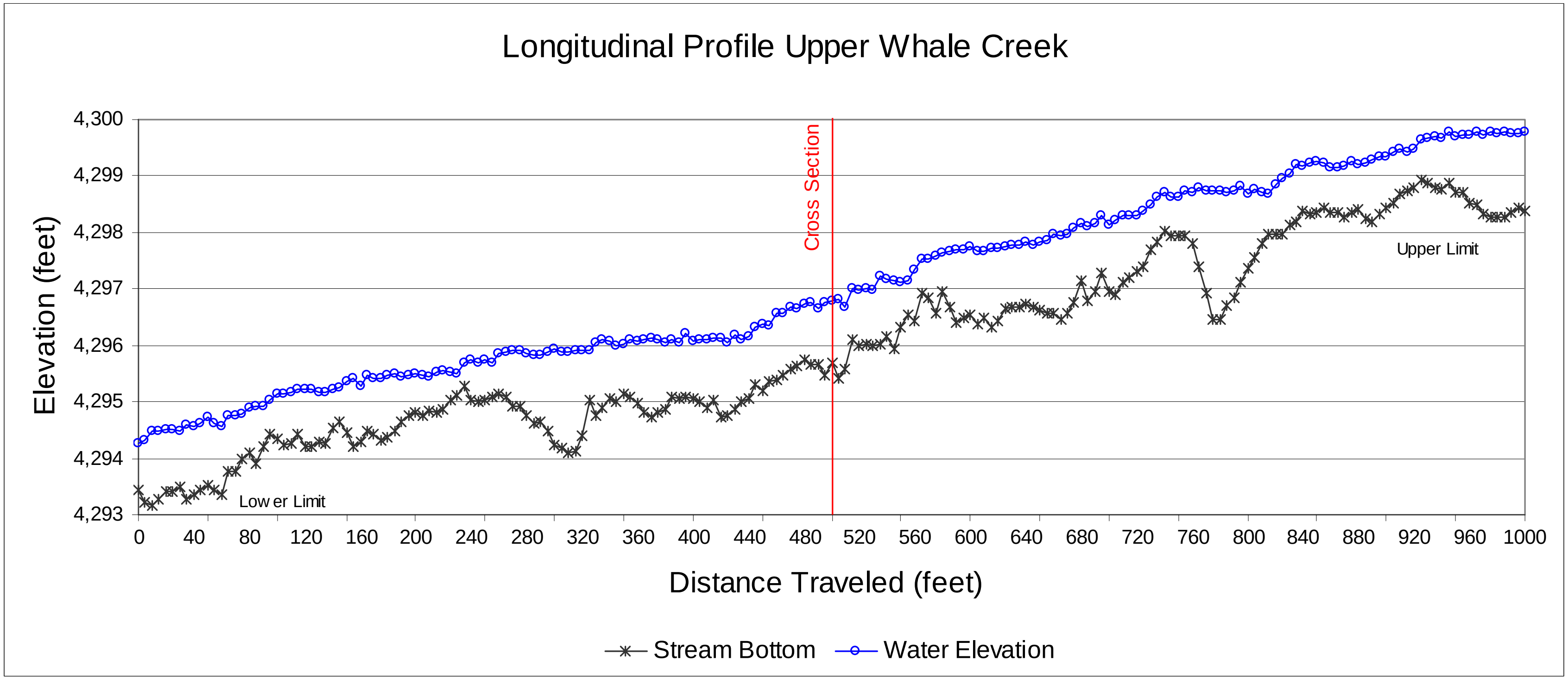
Date: 22 Sept.03
Site Visit Code: profile 2 upper limit
Waterbody: Whale - Upper reach 2
STORET Station ID:
Personnel: CL JG

PEBBLE COUNT								
Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	12		12	9.92%	9.92%
2	Sand		1 - 2	7		7	5.79%	15.70%
3	Very Fine	GRAVELS	2 - 4	3		3	2.48%	18.18%
4	Fine		4 - 6	5		5	4.13%	22.31%
5	Fine		6 - 8	0		0	0.00%	22.31%
6	Medium		8 - 12	7		7	5.79%	28.10%
7	Medium		12 - 16	4		4	3.31%	31.40%
8	Coarse		16 - 22	11		11	9.09%	40.50%
9	Coarse		22 - 32	12		12	9.92%	50.41%
10	Very Coarse		32 - 45	15		15	12.40%	62.81%
11	Very Coarse		45 - 64	17		17	14.05%	76.86%
12	Small	COBBLES	64 - 90	16		16	13.22%	90.08%
13	Small		90 - 128	9		9	7.44%	97.52%
14	Large		128 - 180	3		3	2.48%	100.00%
15	Large		180 - 256			0	0.00%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small		362 - 512			0	0.00%	100.00%
18	Medium		512 - 1024			0	0.00%	100.00%
19	Large		1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			121	0	121	100.00%	

Cross Section



Longitudinal Profile



South Fork Coal Creek

Electronic Forms

enviroNET Watershed Information
Montana Department of Environmental Quality

Report 1 of 1
Select Form

Waterbody: MT76Q002_040 - South Fork Coal Creek(River) - 8.1 Miles

Map Waterbody

Waterbody on year 2000 303d list?: Yes

Assessment Record Sheet
Help

Description:	SOUTH FORK COAL CREEK from headwaters to mouth (CoaL Cr)		
EcoRegion(s):	Northern Rockies	**Hydro Unit:**	17010206
County(s):	FLATHEAD	**Basin:**	Columbia
		Watershed:	Flathead

	Use Support				
Beneficial Uses:	**Fully**	**Threatened**	**Partial**	**Not Supporting**	**Not Assessed**
Agriculture	X				
Aquatic Life Support			X		
Cold Water Fishery - Trout			X		
Drinking Water Supply					X
Industrial	X				
Primary Contact (Recr)	X				

Probable Causes:
Other habitat alterations
Riparian degradation
Siltation

Probable Sources:
Silviculture

Assessment Methods and Information Sources:
Fish surveys
Fixed station physical/chemical monitoring (conventional pollutants only)
Quan. measure of instream parms, channel morph., floodplain; 1-2 seasons; by prof

Report 1 of 1

I. SUFFICIENT CREDIBLE DATA-SOURCE CHECKLIST

WATERBODY LOCATION	TRIBUTARY TO COAL CR
WATERBODY NAME	COAL CR, S FK
WATERBODY NUMBER	MT76Q002_040
HYDROLOGIC UNIT CODE	17010206
WATER CLASSIFICATION	B-1
SEGMENT LENGTH (MILES)	8.1 MILES
ASSESSMENT BY	Perri Phillips
ASSESSMENT DATE (MDY)	[illegible]

DATA SOURCE	CHK'D ?	DOCUMENT TITLES	DOCUMENT LOCATION	ASSIGNED NUMBER	BIOLOGICAL DATA	HABITAT DATA	CHEMISTRY/ PHYSICAL DATA
DEQ	Y	Trelles, S. 1991. Application of the Montana Nonpoint Source Stream Reach Assessment in the Flathead Basin.	NPS files	1		1RPF	
		DEQ. 1989. Stream Reach Assessment.	NPS files	18		18RPF	
FWP	Y	Liknes, G. 1984. The Present Status and Distribution of the Westslope Cutthroat Trout (Salmo Clarki Lewisi) East and West of the Continental Divide in Montana.	NPS files	2	2F		
		F-46-R-2 Va. Hanzel, D., et al. 1989. Survey and inventory of Coldwater and Warmwater Ecosystems. Flathead Lake-River System Study. Statewide Fisheries Investigations.	NPS files	3	3F	3RPF	
		Deleray, M., et al. 1999. Flathead Lake and River System Fisheries Status Report.	NPS files	4	4F		4P
		Weaver, T., et al. 1988. Coal Creek Fisheries Monitoring Study No. VI and Forest-Wide Fisheries Monitoring-1987.	NPS files	5	5F		5P
		Weaver, T. 1989. Coal Creek Fisheries Monitoring Study No. VII and Forest-Wide Fisheries Monitoring-1988.	NPS files	6	6F		
		F-7-10. Read, D., et al. 1982. Fish and Habitat Inventory of Streams in the North Fork Drainage of the Flathead River.	NPS files	7	7F	7RPF	
		Montana Interagency fishery database.	NPS files	13	13F		13P
NRCS	N						
USFS	Y	1995. USDA Flathead National Forest. MT 305 (b) report data request document.	NPS files	8			8P
		USFS. 1998. Watershed biological assessment for bull trout.	NPS files	14	14F	14RPF	14P
		Hauer, F. and E. Hill. 1997. Analysis of 1994 - 1996 headwaters monitoring data: a contribution to the master plan for water quality in the Flathead basin	NPS files	15		15RPF	15N
							15P
		Flathead National Forest. 1995. Montana 305(b) report data request response (letter with attached data)	NPS files	17			17P
USGS	Y	no data					
MRIS	Y	MRIS fishery data.	Database file	9	9F	9LU	9P
						9RPF	
CDs	N						
USFWS	N						
U OF M	Y	Ellis et al., 1998. Water quality in headwater streams in the Flathead National Forest: 1998 biennial report	NPS files	16		16RPF	16P
							16N
							16O
MSU	Y						
MONTANA TECH.	Y						
MRWA	N						
BOR	Y	no data					
DNRC	Y						
BLM	Y	no data					
MDOT	N						
P CRK	N						
MT NAT	N						
CHAMP	N						
CORPS	Y	no data					
MPC	N						
MTDAK UT	N						
TRIBES	N						
MBMG	N						

EPA	Y	Fraley, F., et al. 1981. Flathead River Fishery Study. April 1981.	NPS files	10	10F		
		Shepard, B., et al. 1982. Flathead River Fisheries Study-1982.	NPS files	11	11F		11P
WWP/AVISTA	N						
WDEQ	Y	no data					
YNP	Y	no data					
NPS	Y	no data					
VOLUNTEER	N						
OTHER	Y	1999. Flathead Basin Commission: Biennial Report. 1997-1998.	NPS files	12		12LU	12P
		" "	" "				12C
		" "	" "				12N

SEGMENT DESCRIPTION: South Fork Coal Creek, headwaters to mouth (confluence with Coal Creek).

DATA NOT EXAMINED:

COMMENTS: Good fishery and habitat data. Minimal chemistry data available.

CODES

Biological data: F = fish; M = macroinvertebrates; A = algae; CL = chlorophyll; W = wildlife; E = fecal coliforms; B = other bacteriological data

Water Chemistry & Toxicological data; N = major nutrients; ME = metals; C = common ions, pH, conductivity, miscellaneous.; T = toxicity tests SD=benthic sediment data; O = organics; BA = bioaccumulation

Physical data: P = quantitative physical data; RG = Rosgen type; RI = radiological data

Habitat Data: RPF =riparian and/or instream surveys, and physical features; K=photo points; LU = land use.

NOTE

Biological, Water Quality & Toxicological, and Physical Habitat data were assigned level of information scores from 1 to 4. The level of information is scored in accordance with the technical components, spatial & temporal coverage, and data quality of each data set. The data scoring tables are included in the Montana DEQ's "Sufficient Credible Data for Making Beneficial Use Support Determinations" guidance document. The DEQ's tables are based on tables compiled by the Intergovernmental Task Force on Monitoring Water Quality (TMF) which are included in the EPA's 1997 305(B) Report Guidelines.

2

DRINKING AND CONTACT RECREATION SUFFICIENT CREDIBLE DATA-SCORING TABLES

WATERBODY NAME	COAL CR, S FI
WATERBODY NUMBER	MT76Q002_040
HYDROLOGIC UNIT CODE	17010206

Drinking Water Data Table

Level of Information		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
Insufficient Data	x	**Probable impairments to drinking water were not measured.**		Limited temporal coverage (less than quarterly sampling for <3 yrs).		Data precision & sensitivity is low or unknown.		Data does not reflect current conditions.
		Impairments are inferred.		Data not collected at critical times.		QC protocols not followed or indicates contamination.		
		Probable causes of impairment were not documented.		Limited spatial coverage that does not adequately target probable impairments (e.g., one location).		Detection limits are too high.		
				Limited water quality data with no exceedences of standards, however, sediment data indicates contamination and/or probable sources of impairment are located in the water shed.		Samples not properly preserved.		
Sufficient Credible Data		Total recoverable metals were measured.		Drinking water quality standards are exceeded.		Data precision & sensitivity is moderate.		Data likely reflects current conditions.
		Total & dissolved metals were measured.		A sufficient number of parameters were analyzed.		QA/QC protocols are followed.		There have not been any significant changes in activities occurring in the watershed since the data was collected.
		Organic compounds were measured where contamination is suspected.		At least quarterly sampling or sampling sufficiently targets critical time periods for >2yrs.		Low detection limits.		
		Sampling & analysis includes sediment.		Good spatial coverage or well-targeted sampling location(s).				
		Probable sources of impairment were documented.		Limited water quality data with no exceedences of standards; however, sediment data does not have elevated metals and/or organic compounds and there are no probable sources of impairment located in the watershed.				

Drinking Water Comments	Insufficient chemistry data to assess drinking water beneficial use.

1

Contact Recreation Data Tables for Lakes and Streams (Swimming & Boating)

Level of Information		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
Insufficient Data		Observations of algae blooms, odors, turbidity, aesthetics, etc., without documentation.		Very limited water chemistry or fecal coliform data.		Data precision & sensitivity is low or unknown.		Data does not reflect current conditions.
		Observations made concerning flows or water levels, without documentation.		Data not collected at critical times such as during the summer.		QA/QC protocols were not followed.		
		Observations made concerning surface scums, pollution, toxins, etc. without documentation.		Limited spatial coverage that does not adequately target probable causes of impairments (e.g., one location).		Samples not properly collected, preserved, or exceed holding times.		
				Limited temporal cover.		Poor documentation.		
Sufficient Credible Data		Observations of algae blooms, odors, turbidity, aesthetics, etc. were well documented.		Good temporal coverage of observations, photo documentation, fecal-coliform data, etc.	x	**Data precision & sensitivity moderate.**	x	**It is likely that the data reflects current conditions.**
		Documentation includes photos.	x	**Data & observations are targeted during the summer months.**		QA/QC protocols were followed.		There have not been any significant changes in activities occurring in the watershed since the data was collected.
	x	**Probable sources of impairment identified; probable causes of impairment measured or well documented (toxins, dewatering, etc).**		Good spatial coverage or well targeted sampling location(s).		Low detection limits.		
		Chlorophyll *a* data collected.		Limited water quality data or documentation; however, data indicates severe impairment.				
		Fecal coliform data collected.						
		Information concerning beach closures.						
		Sechii disk data (lakes).						
		Long-time local residents provide similar historical perspectives regarding their observation of changes in water quality over time.						

AQUATIC LIFE /FISHER^IES SUFFICIENT CREDIBLE DATA-SCORING TABLES

TOTAL SCD SCORE	[illegible]
BIO SCORE	2
HABITAT SCORE	3
CHEM./PHYS. SCORE	2

WATERBODY NAME	COAL CR, S F
WATERBODY NUMBER	MT76Q002_04[illegible]
HYDROLOGIC UNIT CODE	17010206

Biology Data Table

Score		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
1		Visual observations of biota were made with no true assessment.		Very limited monitoring.		Data precision and sensitivity is very low or unknown.		Data is not relevant; biological communities may have changed significantly since the assessment was made.
		Simple documentation.		Data is extrapolated from other sites.		Qualified professional does not provide any oversight.		
		Unable to make a comparison to reference condition.				Poor taxonomic resolution.		
		Relative abundance data of fish that is not suppplemented with quantitative data or can not be interpreted by a qualified professional.						
		Fish creel surveys with limited supplemental information.						
2	X	Only one assemblage was assessed (e.g., RBP protocols).		Limited to a single sampling.		Data precision and sensitivity is low to moderate.		Data can be used to give a historical perspective for approximating reference condition or trends.
		Probable sources and causes of impairment are documented.		Limited sampling for site-specific studies.		Data was collected following appropriate protocols; however individuals had limited training.	X	It is unlikely that the biological communities have changed significantly since the survey was conducted.
		Reference condition can be approximated.				Qualified professional provided oversight.		
	X	Relative fish abundance data that can be interpreted by a qualified professional or also includes quantitative fish density			X	Good taxonomic resolution.		
3		Two assemblages assessed or one assemblage with quantitative (e.g., biomass) measurements following SOPs.	X	Monitoring during a single season the norm.		Data has moderate precision and sensitivity.		Data was collected recently or it is very unlikely that the biological community has changed significantly since the survey was conducted.
		Often includes biotic index interpretations.		Monitoring may include site specific studies; however, also has limited spatial coverage of the stream reach.		Qualified professional performs survey or provides training; individual making the survey is well trained.		
		Fisheries data often includes information about growth rates, age class and condition; The entire fish assemblage is targeted.				Qualified professional performs the survey.		
		Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.				Detailed taxonomic resolution.		
4		Two or more assemblages assessed and often includes quantitative measurements following SOPs.	X	Surveys conducted for multiple years and/or seasons.		High precision and sensitivity.		Data is current; There is no doubt that the biological survey reflects current conditions.
		Reference condition is well understood and is used as the basis of the assessment.		Broad coverage of sites.		Assessment performed by a highly experienced qualified professional.		
		Often includes biotic index interpretations.		Often uses targeted or probabilistic design.				

Biology Comments

Good fishery studies, but no other assemblages assessed. Score is a 2.

1

Chemistry Data Table *(Includes Toxicity Testing)*

Score		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
1		Best professional judgment based on land use data or source location.		Low spatial and temporal coverage; limited data at critical periods.		Data precision and sensitivity is very low or unknown and data appears to be an outlier (suspect).		Data does not reflect current conditions.
		Chemical parameters analyzed are limited and do not provide sufficient information concerning probable causes of impairment.		Limited period of record (e.g., one day).		High detection limits make the data difficult or impossible to interpret.		Data can only be used for determining trends or reference condition.
		Data extrapolated from an upstream or downstream station where homogeneous conditions are expected.				QC protocols indicate contamination, etc.		
						QA/QC protocols were not followed.		
2	x	**Usually grab or composite water quality samples.**	x	**Moderate spatial and/or temporal coverage.**		Data quality and sensitivity is low to moderate		Data is substantially older than ideal, but appears to be a reasonable indicator of current conditions.
		Synthesis of historical information on fish contamination levels.		Data collected at critical periods (e.g., spring, summer, spawning season).		Data was collected following appropriate protocols; however individuals had limited training.		
		Screening models based on loading data (not calibrated or verified).		Short period of record, however good spatial coverage.		Low detection limits.		
		Sediment contamination data (e.g., metal scans).		Quarterly sampling.		QC indicates there was no contamination, etc.		
		Limited chemical parameters; however probable impairment causes are targeted and probable sources of impairment documented.				Low replication used for toxicity tests.		
		Reference condition can be approximated by a qualified professional.						
		Acute or chronic WET; or acute ambient; or acute sediment tests.						
3		Series of grab or composite samples (diurnal coverage as appropriate).		Broad spatial and temporal coverage of site with sufficient frequency and coverage to capture acute events.	x	**Data has moderate precision and sensitivity.**	x	**Data is older than ideal, but there are no indications that the condition it reflects have changed significantly.**
		Calibrated models		Typically monthly sampling during key periods.		Qualified professional provides training; the individual collecting the samples is well trained.		
		Width/depth integrated sampling		Lengthy period of record (sampled over a period of months for >2 years).	x	**Qualified professional collected samples; data is analyzed in a competent laboratory that uses methods with low detection limits.**		
		Combination of two or more of the following analyses; water column, sediment, chlorophyll, toxicity testing, or bioaccumulation data.				QC documents where there are no sampling or analytical errors.		
		Reference condition can be determined with reasonable confidence and used as a basis for assessment.				Moderate replication used for toxicity tests.		
		2-3 acute or chronic ambient; or acute sediment; or acute and chronic WET tests for effluent-dominated systems.						
4		Combination of 3 or more of the following : water column chemistry, sediment chemistry, chlorophyll or bioaccumulation data; or toxicity testing.		Broad spatial (several) & temporal coverage (monthly sampling during key periods for >3 yrs) of site with sufficient frequency & parameter coverage to capture acute events, chronic conditions and other potential impacts.		High precision and sensitivity.		Data is current. Generally less than five yrs old and/or there is a high certainty level that conditions have not changed since it was collected.
		3 or more acute and chronic ambient tests; or acute or chronic sediment tests.				Data collected and analyzed by qualified professionals following detailed QA/QC protocols.		
						High replication used for toxicity tests.		

Chemistry Comments	
	Nutrient and organic carbon data collected by the USFS at one sampling station in the 1990's; no metals data were collected; but no mines located in drainage; TSS data collected from 1983 - 1994

Habitat/Physical Data Tab[illegible]

Score		Technical Components		Spatial/Temporal Cov[illegible]		Data Quality		Data Currency
1		Visual observations of habitat characteristics were made with no true assessment.		Sporadic visits; assessments are [illegible] [illegible]e at limited access points such as road crossings.		Data precision and sensitivity is very low or unknown.		Data is not relevant; habitat has [illegible] [illegible]ges significantly since the assessment was made.
		Only has documentation of land use practices that might alter habitat.				Data was not collected by a trained individual following appropriate protocols.		
		No attempt to compare to reference condition; observed impacts are likely to be natural.						
2		Visual observations of habitat characteristics were made with simple assessment.		Limited to annual visit and non-specific to season.		Data precision and sensitivity is low.		Data can be used to give a historical perspective for approximating reference condition or trends.
		Use of land use maps to characterize watershed condition; probable sources of impairment are documented.		Limited spatial coverage.		Data was collected following appropriate protocols; however sampler had limited training.		It is unlikely that the habitat has changed significantly since the assessment was made.
		Reference condition can be approximated by a qualified professional.		Site specific studies.		Qualified professional involved only through correspondence.		
3	X	**Use of visual-based habitat assessment following standard SOPs (e.g., stream reach assessment and PFC).**		Assessment during a single season norm.	X	**Data has moderate precision and sensitivity.**	X	**Data was collected recently or it is very unlikely that the habitat has changed significantly since the assessment was made.**
		Documentation includes photographs.	X	**Assessment is broad; often covering the entire stream reach or region.**		Qualified professional performs survey or provides training; the individual making the assessment is well trained.		
		Assessment includes quantitative measurements of selected parameters.		An attempt was made to access the stream reach wherever possible.		Qualified professional performs the assessment.		
	X	**Data on land are used to suppliment assessment.**						
		Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.						
4		Assessment of habitat based on quantitative measurements of instream parameters, channel morphology, & floodplain characteristics.		Good access of the entire stream reach, including private property.		High precision and sensitivity.		Data is current; There is no doubt that the assessment reflects current conditions.
		Reference condition is well understood and is used as the basis of the assessment.		Helicopter surveys, etc.		Assessment was performed by a highly experienced professional.		
				Data from multiple years.				

Habitat Comments

Good habitat description. Score is a 3.

3

LAKES AND WETLANDS SUFFICIENT CREDIBLE DATA-SCORING TABLES

T… SCORE	0
…ORE	
HAB…AT SCORE	
CHEM./PHYS. SCORE	

WATERBODY NAME	COAL CR, S…
WATERBODY NUMBER	MT76Q002_…
HYDROLOGIC UNIT CODE	0

Biology Data Table

Score	Technical Components	Spatial/Temporal Coverage	Data Quality	Data Currency
1	Simple documentation, visual observations only (no true assessment).	Very limited monitoring.	Data precision and sensitivity is very low or unknown.	Data does not reflect current conditions.
	Unable to make a comparison to reference condition.		Qualified professional does not provide any oversight.	Data can only be used for determining trends or inference condition.
	Relative abundance data of fish that is not supplemented with quantitative data or can not be interpreted by a qualified professional.		Poor taxonomic resolution.	
	Fish creel surveys with limited supplemental information.			
2	Only one biological assemblage was surveyed or observed (usually fish or algae); includes sufficient documentation that can be interpreted by a qualified professional.	Limited to a single sampling.	Data precision and sensitivity is low to moderate.	Data is substantially older than ideal, but there is reason to believe that it is a good indicator of current conditions.
	Probable sources and causes of impairment are documented.	Limited sampling for site-specific studies.	Data was collected or observations were made following appropriate protocols; however individuals had limited training.	
	Reference condition can be approximated by a qualified professional.		Qualified professional provided oversight.	
			Good taxonomic resolution.	
3	Relative abundance data or well-documented observations for 2 biological assemblages such as fish, algae, macroinvertebrates, amphibians, etc., with quantitative (e.g. population, growth rate, primary production, age class, size, condition) data for at least one assemblage.	Monitoring during a single season the norm.	Data has moderate precision and sensitivity.	Data is older than ideal, but there are no indications that the conditions it reflects have changed significantly.
	May includes biotic index interpretations.	Monitoring may include site specific studies but also has limited spatially coverages.	Qualified professional performs survey or provides training; the individual making the survey is well trained.	
	The entire fish assemblage may not be targeted, however all fish species sampled were identified.		Qualified professional performs the survey or makes observations	
	Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.		Detailed taxonomic resolution.	
	The entire fish assemblage may not be targeted, however all fish species sampled were identified.			
4	Two or more assemblages were surveyed and assessed; includes quantitative measurements for at least two assemblages following detailed SOP's.	Surveys conducted for multiple years and/or seasons.	High precision and sensitivity.	Data is current. Generally it is less than five yrs old, and/or there is certainty that the conditions have not changed since it was collected.
	Reference condition is well understood and is used as the basis of the assessment.	Broad coverage of sites.	Assessment performed by a highly experienced professional.	
	The fish survey was designed to sample the entire fish assemblage	Often uses targeted or probabilistic design.	Detailed taxonomic resolution.	
	Often includes biotic index interpretations.			

Biology Comments

1

Chemistry Data Table(includes Toxicity Testing)

Score	Technical Components	Spatial/Temporal Coverage	Data Quality	Data Currency
1	Best professional judgment based on land use data or source locations.	Low spatial & temporal coverage - limited data at critical periods.	Data precision & sensitivity is very low or unknown & data appears to be an outlier (suspect).	Data does not reflect current conditions.
	Limited chemical analyses which do not provide sufficient information concerning probable causes of impairment.	Limited period of record (e.g., one day)	High detection limits make the data difficult to interpret.	Data can only be used for determining trends or reference condition.
	Data extrapolated when homogeneous conditions are expected.		QA/QC protocols not followed.	
2	Usually grab or composite water quality samples.	Moderate spatial and/or temporal coverage.	Data quality & sensitivity is low to moderate.	Data is substantially older than ideal, but there is reson to believe that it is a good indicator of current conditions.
	Screening models based on loading data (not calibrated or verified).	Data collected at critical periods (lakes sampled near turnover, late winter and/or mid-summer; wetlands sampled in the spring or summer).	Data was collected following appropriate protocols; however field personnel had limited training.	
	Sediment contamination data (e.g., metal scans).	Short period of record; however good spatial coverage.	Low detection limits.	
	Chemical parameters limited; however probable causes of impairment were targeted; probable sources of impairment were documented.	Quarterly sampling or targeted seasonal-sampling.	QC indicates there was no contamination or other problems.	
	Reference condition can be approximated by a professional.	Several parameters often collected over several years (e.g., Secchi depth).	Low replication used for toxicity tests.	
	Acute or Chronic WET; or Acute ambient; or acute sediment tests.			
	Synthesis of historical information on fish contamination levels for lakes.			
	N/P ratios calculated for lakes.			
	Trophic status determine for lakes using at least 2 of the following ; transparency, primary production, phytoplankton density and/or biomass, TOC, total nitrogen, total phosphorus or chlorophyll a.			
3	Series of grab or composit samples (depth integrated & diurnal coverage as appropriate)	Broad spatial & temporal coverage of site with sufficient frequency & coverage to capture acute events (lakes sampled near turnover; late winter or mid summer; wetlands samped in late winter/early spring & mid-summer.	Data has moderate precision & sensitivity.	Data is older than ideal, but there are no indications that the condition it reflects have changed significantly.
	Calibrated models.	Typically monthly sampling during key periods.	Qualified professional provides training; the individual collecting samples is well trained.	
	Combination of two or more analyses of the following: water column, sediment, chlorophyll; toxicity testing; primary production; bioaccumulation.	Lengthly period of record (sampled over a period of months for >2yrs).	Qualified professional collects samples; Data is analyzed in a competent laboratory that uses methods with low detection limits.	
	Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.		QC documents that there are no sampling or analytical errors.	
	2-3 acute or chronic ambient; or acute sediment; or acute and chronic WET tests for effluent dominated system.		Moderate replication used for toxicity tests.	
	Trophic status determined using Secchi depth or transparency, total phosphorus, and chlorophyll a ; includes a dissolved oxygen/temperature profile(s) for lakes.			
	N/P ratios calculated for lakes.			

4	Combination of three or more of the following: water-column chemistry, sediment chemistry, chlorophyll a , primary production, bioaccumulation data, or toxicity testing	Broad spatial (several) & temporal coverage (monthly sampling during key periods for [illegible] ile with sufficient frequency & parameter[illegible] apture acute events, chronic conditio[illegible] ential impacts.	High precision & sensitivity.	Data is current. Generaly it is less than 5 yrs old, and /or there is certainty that conditions have not changed since it was collected.
	Includes trophic status, dissolved oxygen profiles & N/P ratio (lakes) >3 acute & chronic ambient tests; or acute or chronic sediment tests.		Data collected & analyzed by qualified professionals following detailed QA/QC protocols.	
	Includes sediment core sampling.		High replication used for toxicity	

Chemistry Comments

3

Habitat/Physical Data Table

Score		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
1		Visual observations of habitat characteristics with no true assessment.		Sporadic visits, assessments are only made at limited areas.		Assessment precision & sensitivity is very low or unknown.		Data does not reflect current conditions.
		Simple documentation of practices that might alter habitat.				Assessment was not conducted by trained individual(s).		Data can only be used for determining trends or reference condition.
		No attempt to compare to reference condition; observed impacts are likely to be natural.						
2		Visual observations of habitat characteristics or impairments (e.g., shoreline erosion, fluctuating water levels, siltation, riparian & aquatic vegetation, grazing, buffer zones, spawning areas, wildlife habitat/use) were made with simple assessment.		Limited to annual visit & non-specific to season.		Assessment precision & sensitivity is low.		Data is substantially older than ideal, but there is reason to believe that it is a reasonable indicator of current conditions.
		Use of landuse maps to characterize watershed condition; probable impairment causes & sources documented.		Limited spatial coverage.		Assessment was undertaken following appropriate protocols; however individuals had limited training.		
		Reference condition can be approximated by a qualified professional.		Site- specific studies.		Qualified professional only involved through correspondence.		
3		Use of visual-based habitat assessment following SOPs; may include a detailed interpretation.		Assessment during a single season the norm.		Data has moderate precision & sensitivity.		Data is older then ideal, but there are no indications that the condition it reflects have changed significantly.
		Documentation includes photographs.		Assessment is broad, often covering the entire water body.		Qualified professional provides training; the individual making the assessment is well trained.		
		Sources & causes of impairment are well documented & understood.				Qualified professional performs the assessment & makes interpretations.		
		Information concerning surrounding land-use and/or reservoir management activities are used to supplement assessment.						
		Reference condition can be determined with a reasonable degree of confidence & used as a basis for assessment.						
4		Assessment includes quantitative measurements of selected parameters.		Assessment is broad; often covering the entire water body; data collected from multiple years.		High precision & sensitivity.		Data is current. Generally it is less than 5 yrs old, and/or there is certainty that conditions have not changed since it was collected.
		Aerial photographs, satellite images or infrared photographs are used as part of the assessment.		Aerial surveys that are ground-truthed.		Assessment was performed by a qualified professional following detailed protocols.		
		Detailed studies conducted to determine impacts to habitat caused by dam operations, etc.						
		Reference condition is well understood & is used as the basis of the assessment.						

II. BENEFICIAL USE-SUPPORT DETERMINATION: DATA MATRIX
Section 1 of 3

WATERBODY NAME	COAL CR, S FK
WATERBODY NUMBER	MT76Q002_040
HYDROLOGIC UNIT CODE	17010206

Spatial Layout of Data-Biological

Document Number & Code	Data Parameter	Upstream									Downstream
		Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name
		entire stream									
	I. Biological Data										
	A. Fisheries Data										
14F	1998 report	bull trout, westslope cutthroat, mtn whitefish, sculpin present; 1979 - 1997 redd counts & bull trout population estimates from S Frk Coal Creek with no significantly declining trends as indicated by Mann Kendall trend analysis; bull trout subpop in Coal Creek declining (according to report text) and functioning at unacceptable risk due to late '80s drought, overfishing & habitat modification & competition/predation occurring with lake trout									
13F	1989 database	cutthroat common, bull trout abundant									
2F	1984 report	cutthroat common; pure based on absence of contaminating species or competitors; highest value to high priority habitat									
9F	MRIS database	outstanding fisheries resource; headwaters to mouth - NWPCC fisheries protected area; mouth to Mathias: bull common, westslope cutthroat common, sculpin abundant; Mathias to headwater: bull common, cutthroat uncommon; pop estimates (# per 1000 ft) for mouth to Mathias Crk - 8/85: 61 bull, 82 cutthroat; 8/87: 10 bull, 38 cutthroat; 8/88: 28 bull, 37 cutthroat; 9/89: 12 bull, 57 cutthroat; 8/90: 50 bull, 42 cutthroat; 8/14/91: 65 bull; 8/15/91: 70 bull; 8/10/91: 60 bull, 20 cutthroat ; WCT 100% pure based on 8/14/84 sample genetics analysis									
4F	1999 report	bull trout densities (age 1+) in #/100m2 - 85: 8.91; 87: 1.16; 88 2.48; 89: 1.73; 90: 4.38; 91: 4.38; 92: 5.38; 93: 1.45; 94: 0.75; 95: 3.77; 96: 0.41; 97: 1.98; 98: 0.16 ;SIGNIFICANT decline in bull trout density from 1989 to 1998 based on Mann Kendall trend analysis; juvenile density over this period has averaged 3.03 per 100 m2 (density is currently low); estimated abundance & densities have fluctuated more in S Fk ~~than other sections in Coal Ck~~ drainage, possibly due to unstable nature of channel resulting from past management activities									
3F	1989 report	no additional data									
5F	1988 report	no additional bull trout data; 8/85 - 83 cutthroat per 100m; 8/87 - 43 cutthroat per 100 m									
6F	1989 report	3 yrs data on juveniles (no dates specified fo 3 yrs of data) - juvenile bulls - 417 max, 153 mean; juvenile westslope cutthroat - 46 max, 40 mean - highest fluctuations in Coal Crk drainage; 8/88 - 43 westslope cutthroat per 100m									
7F	1982 report	no additional data (data reported in other references)									
	B. Macroinvertebrate Data										
	C. Periphyton Data										
	1. Algae										

1

2. Chlorophyll a	
D. Bacteriological Data	
E. Wildlife	

2

Section 2 of 3

WATERBODY NAME	COAL CR, S FK
WATERBODY NUMBER	#N/A
HYDROLOGIC UNIT CODE	0

Spatial Layout of Data-Habitat

		Upstream									Downstream
		Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name
Document Number & Code	Data Parameter										
	II. Habitat Data										
	A. Instream/Riparian Habitat and Physical Features										
14RPF	1998 report	no man made barriers; rearing habitat is good; 1976 - 1985 R-1 stream channel stability ratings = 62 to 120, ranging b/w good and poor conditions, with increasing rating values (declining trend); 7.5% water yield increase modeled for S Frk; impacted by roads and logging									
15RPF	1997 report	25% logged in early 1950's									
16RPF	1998 report	some of older harvests included roads & skid trails in riparian zones which may still be affecting hydrologic function by changing runoff patterns and timing; soils in Coal Crk watershed more erodable due to texture & overall lack of cohesion - expected to have higher TSS & more prone to increased channel erosion with increased levels of forest management									
18RPF	1989 DEQ Stream Reach Assessment	headwaters to Mathias Creek confluence- significant logging adjacent to stream; logging slash in stream; minor bank undercutting; high gradient cobble/rubble channel with minor sand deposition in riffles & in areas with low velocity; canopy removal by logging, in some cases right down to stream, but revegetation is good; 51 - 75% shading; some avalanche-related large debris jams near Mathias Creek; embeddedness <30%; little natural erosion; banks & rip zone well vegetated; cut logs observed in debris jams; roads have propoer drainage & adequate culvert size at crossings; larger buffer strip for SMZ; only impacts from logging are increased slash and light penetration to channel; score = 82% (full support)	Mathias Creek confluence to mouth - large avalanche chutes evident, but no active erosion; logging > 10 yrs old for a 2 mile stretch with no SMZ; no NPS pollution evident - some embeddedness (30%) but not attributable to logging (but deposition greater than would be expected); good bank stability & good recovery in cut areas; FWP & USFS have installed 10 deflectors to improve fish habitat (appear to be working well); 75% trees, 20% shrubs, 5% grasses & forbs; sed deposition none or minimal; aquatic plant growth not common; skid roads revegetated with good drainage bars; substantial canopy removal by logging;slash & natural debris have been removed from channel; score = 85% (full support)								
13RPF	1979 assessment	gradient = 0.03; avg ch width = 15 m; 3% pool, 40% run, 50% riffle, 7% pocket water; rating for cutthroat habitat = best; 20% fines; channel stability rating = fair; encroachment by road/RR; channelization									
9RPF	MRIS database	mouth to Mathias confluense: 3% pool ratio, 40% run ratio, 50% riffle ratio, 7% pocket ratio; subsurface cover fair; gradient 3%; Mathias to headwaters: gradient = 11.1%, 6% pool ratio, 305 run ratio, 50% riffle ratio, 12% pocket ratio									

3

4RPF	1999 report	**mouth to Mathias confluence** - sampling section located approx 2 km upstream from gate on USFS Road 317: channel unconfined, gradient < 3%; substrate dominated by cobble; riffle/run habitat with low to moderate amts of woody debris; clear-cut in late 70s & in several locations channel artificially straightened with heavy equipment; highly unstable & extensive bedload movement occurs during high Qs - spawning area just upstream from this section; despite instability, habitat indecies indicate adequate conditions									
3RPF	1988 report	all substrate scores indicative of good rearing habitat quality									
6RPF	1989 report	major sediment contributing areas & large quantities of fine material documented above a series of relatively stable beaver dams; data from 2 habitat enhancement sections (locations unknown - called 'upper ' & 'lower'):D90 = 16, 38; substrate scores = 13.2, 11.2; post-treatment increases in cover = 338%, 837%; habitat assessment: **headwaters to Mathias Creek** - natural sed sources; clearcut near headwaters had adequate SMZ; logging debris presnt throughout canyon section causing excessive deposition of fine material and active channel migration; on lower end, highly unstable channel - inadequate SMZs observed on cuts in this area & cut stumps observed in channel, active ch migration created major sed source; evidence of machine operation in off channel wet areas; logging debris in channel here removed; deposition from this area noted downstream;	**Mathias Crk to mouth** - beaver activity below Mathias Crk confluence; heavily logged area (1.1 km length) with no SMZ - - site of habitat enhancement sections; mechanical channelization evident; high levels of large, stable debris & active ch migration resulted in extensive deposition observed to the mouth from this source								
1RPF	1991 report	data reported in 18RPF									
7RPF	1982 report (9/79 survey)	**mouth to Mathias** - avg wetted width = 6m; 505 riffle, 40% run, 7% pocketwater, 3% pool; channel debris moderate to low & 20% of debris stable; overhanging veg & instream cover moderate; upper bank slope 30 to 40%; valley to channel ratio = 4:1; channel occasionally confined & had an irregular pattern; avg ch width = 15m; avg depth = 0.22m; 20% fines; **Mathias to headwaters** - avg wetted width = 3.5m; avg ch width = 10m; avg depth = 0.12; 30% fines; 50% riffle, 30% run, 12% pocketwater, 8% pool; channel debris low with 30% stable material; instream cover & bank cover low; gradient = 11.1%; upper bank slope = 30 to 40%; valley to channel ratio = 3:1									
	B. Photo Points										
	C. Land Use										
9LU	MRIS database	**headwaters to Mathias confluence**: almost entirely public lands; natural beauty but lacking pristine setting; presence of human development; **Mathias confluence to mouth** - almost entirely public lands; clean stream in natural setting									

4

	2. Metals	
	3. Common ions, pH, misc.	
	4.Toxicity tests/Bioaccumulation	
	C. Benthic sediment data	
	D. Organics	
16O	*5/97 - 10/97 grabs*	0.05 to 0.38 mg/l - fairly consistently, concs lower than N Frk and Coal Crk

6

Section 2 of 3

WATERBODY NAME	COAL CR, S FK
WATERBODY NUMBER	#N/A
HYDROLOGIC UNIT CODE	0

Spatial Layout of Data-Habitat

Document Number & Code	Data Parameter	Upstream Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Downstream Site/Reach Name
	II. Habitat Data										
	A. Instream/Riparian Habitat and Physical Features										
14RPF	1998 report	no man made barriers; rearing habitat is good; 1976 - 1985 R-1 stream channel stability ratings = 62 to 128, ranging b/w good and poor conditions, with increasing rating values (declining trend); 7.6% water yield increase modeled for S Frk; impacted by roads and logging									
15RPF	1997 report	25% logged in early 1950's									
16RPF	1998 report	some of older harvests included roads & skid trails in riparian zones which may still be affecting hydrologic function by changing runoff patterns and timing; soils in Coal Crk watershed more erodable due to texture & overall lack of cohesion - expected to have higher TSS & more prone to increased channel erosion with increased levels of forest management									
18RPF	1989 DEQ Stream Reach Assessment	headwaters to Mathias Creek confluence: significant logging adjacent to stream; logging slash in stream; minor bank undercutting; high gradient cobble/rubble channel with minor sand deposition in riffles & in areas with low velocity; canopy removal by logging, in some cases right down to stream, but revegetation is good: 51 - 75% shading; some avalanche-related large debris jams near Mathias Creek; embeddedness <30%; little natural erosion; banks & rip zone well vegetated; cut logs observed in debris jams; roads have proper drainage & adequate culvert size at crossings; larger buffer strip for SMZ; only impacts from logging are increased slash and light penetration to channel; score = 82% (full support)	Mathias Creek confluence to mouth - large avalanche chutes evident, but no active erosion; logging > 10 yrs old for a 2 mile stretch with no SMZ; no NPS pollution evident - some embeddedness (30%) but not attributable to logging (but deposition greater than would be expected); good bank stability & good recovery in cut areas; FWP & USFS have installed 10 deflectors to improve fish habitat (appear to be working well); 75% trees, 20% shrubs, 5% grasses & forbs; sed deposition none or minimal; aquatic plant growth not common; skid roads revegetated with good drainage bars; substantial canopy removal by logging;slash & natural debris have been removed from channel; score = 86% (full support)								
13RPF	1979 assessment	gradient = 0.03; avg ch width = 15 m; 3% pool, 40% run, 50% riffle, 7% pocket water; rating for cutthroat habitat = best; 20% fines; channel stability rating = fair; encroachment by road/RR; channelization									
9RPF	MRIS database	mouth to Mathias confluence: 3% pool ratio, 40% run ratio, 50% riffle ratio, 7% pocket ratio; subsurface cover fair; gradient = 3%; Mathias to headwaters: gradient = 11.1%; 8% pool ratio, 305 run ratio, 50% riffle ratio, 12% pocket ratio									

3

4RPF	*1999 report*	**mouth to Mathias confluence** - sampling section located approx 2 km upstream from gate on USFS Road 317: channel unconfined, gradient < 3%; substrate dominated by cobble; riffle/run habitat with low to moderate amts of woody debris; clear-cut in late '70s & in several locations channel artificially straightened with heavy equipment; highly unstable & extensive bedload movement occurs during high Qs - spawning area just upstream from this section; despite instability, habitat indecies indicate adequate conditions									
3RPF	*1988 report*	all substrate scores indicative of good rearing habitat quality									
6RPF	*1989 report*	major sediment contributing areas & large quantities of fine material documented above a series of relatively stable beaver dams; data from 2 habitat enhancement sections [locations unknown - called 'upper ' & 'lower'] D90 = 16, 38; substrate scores = 13.2, 11.2; post-treatment increases in cover = 336%, 837%; habitat assessment: **headwaters to Mathias Creek** - natural sed sources; clearcut near headwaters had adequate SMZ; logging debris preent throughout canyon section causing excessive deposition of fine material and active channel migration; on lower end, highly unstable channel - inadequate SMZs observed on cuts in this area & cut stumps observed in channel; active ch migration created major sed source; evidence of machine operation in off channel wet areas; logging debris in channel here removed; deposition from this area noted downstream;	**Mathias Crk to mouth** - beaver activity below Mathias Crk confluence; heavily logged area (1.1 km length) with no SMZ - - site of habitat enhancement sections; mechanical channelization evident; high levels of large, unstable debris & active ch migration resulted in extensive deposition observed to the mouth from this source								
1RPF	*1991 report*	data reported in 18RPF									
7RPF	*1982 report (9/79 survey)*	**mouth to Mathias** - avg wetted width = 6m; 505 riffle, 40% run, 7% pocketwater, 3% pool; channel debris moderate to low & 20% of debris stable; overhanging veg & instream cover moderate; upper bank slope 30 to 40%; valley to channel ratio = 4:1; channel occasionally confined & had an irregular pattern; avg ch width = 10m; avg depth = 0.22m; 20% fines; **Mathias to headwaters** - avg wetted width = 3.5m; avg ch width = 10m; avg depth = 0.12; 30% fines; 50% riffle, 30% run, 12% pocketwater, 8% pool; channel debris low with 30% stable material; instream cover & bank cover low; gradient = 11.1%; upper bank slope = 30 to 40%; valley to channel ratio = 3:1									
	B. Photo Points										
	C. Land Use										
9LU	*MRIS database*	**headwaters to Mathias confluence**: almost entirely public lands; natural beauty but lacking pristine setting; presence of human development;**Mathias conflence to mouth** - almost entirely public lands; clean stream in natural setting									

4

Upper South Fork Coal Creek

Site Visit Form

Place Site Visit Label Here

03-0934

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-C06.
Trip ID: 2003-FLTHD Date: 8/27/03
Personnel: Laidlaw /Pridmore

Waterbody Name South Fork Coal Creek County Flathead HUC 17010206
Station ID C06COLSC01 Visit # 1 Location Above Conf w/ mainstem Coal
Lat 48.67474 Long 114.40942 Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

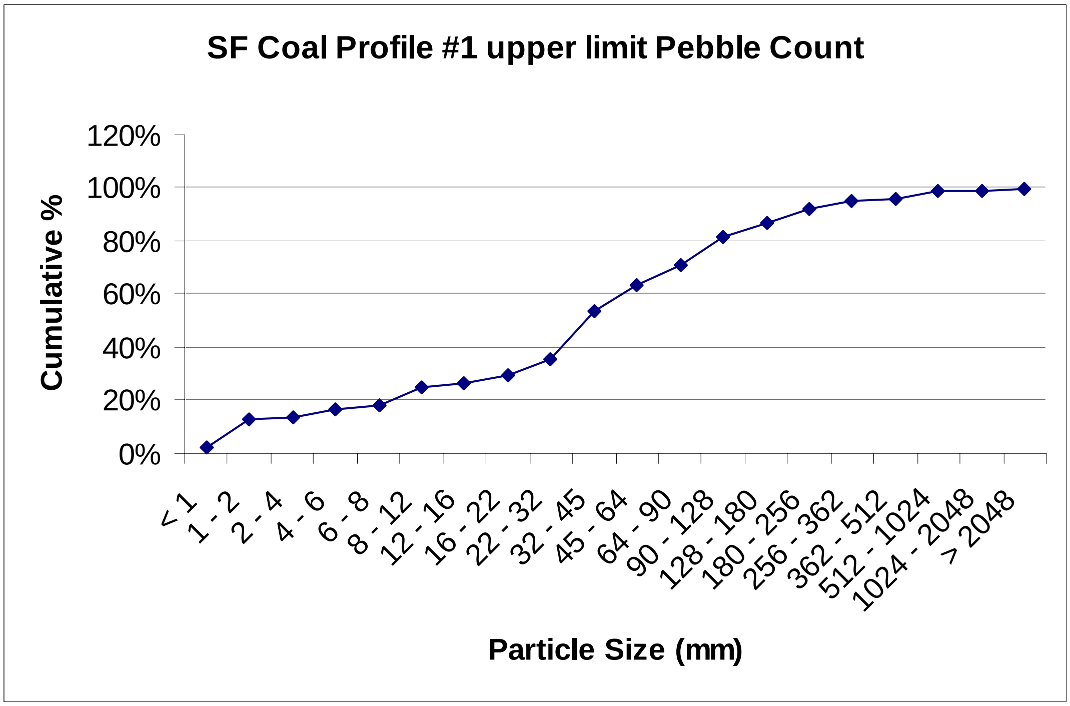
Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0934M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☐	(see comments)		
Other				

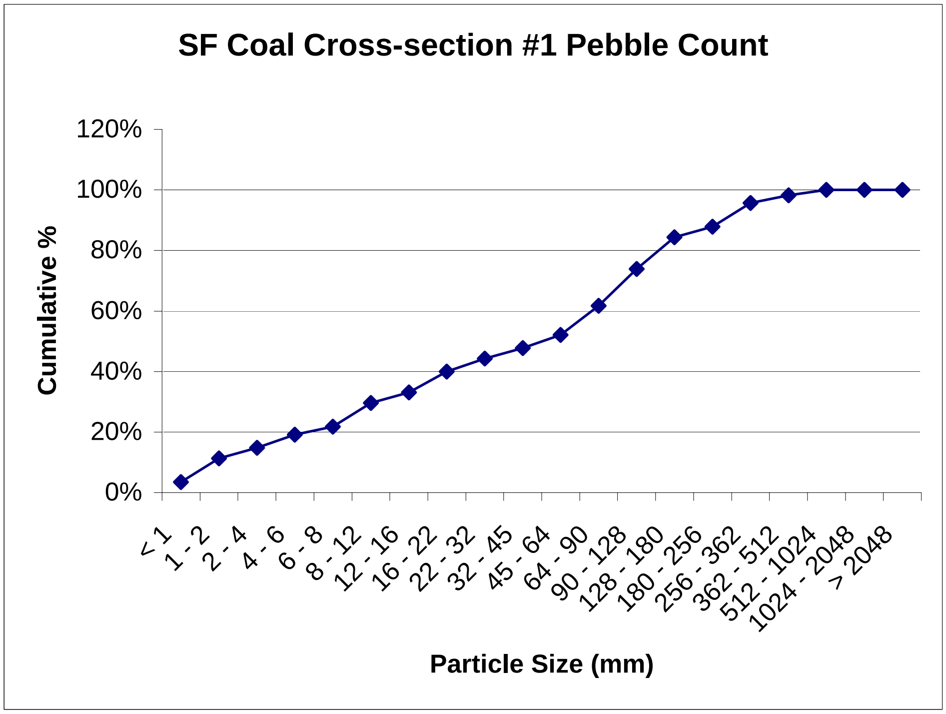
Measurements:	Time: 17:00	
Q / Flow (cfs)	— Est. ☐	
Temp: (°C)	W —	A —
pH:	—	
SC: (mS/cm)	—	
SC x 1000 =	— µmho/cm	
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

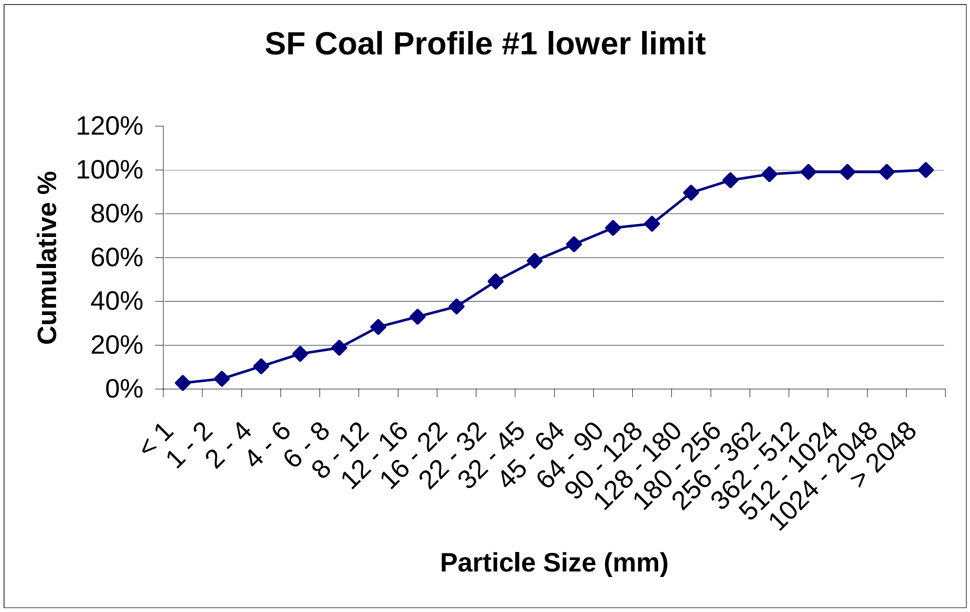
Macroinvertebrate Kick Duration: 15 minutes Kick Length (Ft.): 100'

Site Visit Comments: Elev= 3942'
upstream of old FS bridge
steep slopes - dense tree stands, diverse + extensive riparian veg
large boulder/cobble
cascades + riffles
little bank erosion
Caught 7 long-tailed tadpoles
old historic clearcuts above, mostly wooded now

Pebble Counts






SF Coal Profile #1 lower limit
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)

SUBSTRATE DEQ/MDM								
Date: 15 Sept.03				**Site Visit Code:** Profile #1 upper limit				
Waterbody: SF Coal Cr.				**STORET Station ID:** 0690591 / 5394174				
Personnel: djp, cll								
PEBBLE COUNT								
Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				0.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	2		2	1.98%	1.98%
2	Sand		1 - 2	11		11	10.89%	12.87%
3	Very Fine	GRAVELS	2 - 4	1		1	0.99%	13.86%
4	Fine	GRAVELS	4 - 6	3		3	2.97%	16.83%
5	Fine	GRAVELS	6 - 8	1		1	0.99%	17.82%
6	Medium	GRAVELS	8 - 12	7		7	6.93%	24.75%
7	Medium	GRAVELS	12 - 16	2		2	1.98%	26.73%
8	Coarse	GRAVELS	16 - 22	3		3	2.97%	29.70%
9	Coarse	GRAVELS	22 - 32	6		6	5.94%	35.64%
10	Very Coarse	GRAVELS	32 - 45	18		18	17.82%	53.47%
11	Very Coarse	GRAVELS	45 - 64	10		10	9.90%	63.37%
12	Small	COBBLE	64 - 90	8		8	7.92%	71.29%
13	Small	COBBLE	90 - 128	10		10	9.90%	81.19%
14	Large	COBBLE	128 - 180	6		6	5.94%	87.13%
15	Large	COBBLE	180 - 256	5		5	4.95%	92.08%
16	Small	BOULDERS	256 - 362	3		3	2.97%	95.05%
17	Small	BOULDERS	362 - 512	1		1	0.99%	96.04%
18	Medium	BOULDERS	512 - 1024	3		3	2.97%	99.01%
19	Large	BOULDERS	1024 - 2048			0	0.00%	99.01%
20	Bedrock	BOULDERS	> 2048	1		1	0.99%	100.00%
21	Total # Samples				0	101	100%	

SUBSTRATE DEQ/MDM

Date: 15 Sept.03 **Site Visit Code:** cross-section #1

Waterbody: SF Coal Cr. **STORET Station ID:** 0690709 / 5350463

Personnel: djp, cll

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				0.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	4		4	3.48%	3.48%
2	Sand		1 - 2	9		9	7.83%	11.30%
3	Very Fine	GRAVELS	2 - 4	4		4	3.48%	14.78%
4	Fine	GRAVELS	4 - 6	5		5	4.35%	19.13%
5	Fine	GRAVELS	6 - 8	3		3	2.61%	21.74%
6	Medium	GRAVELS	8 - 12	9		9	7.83%	29.57%
7	Medium	GRAVELS	12 - 16	4		4	3.48%	33.04%
8	Coarse	GRAVELS	16 - 22	8		8	6.96%	40.00%
9	Coarse	GRAVELS	22 - 32	5		5	4.35%	44.35%
10	Very Coarse	GRAVELS	32 - 45	4		4	3.48%	47.83%
11	Very Coarse	GRAVELS	45 - 64	5		5	4.35%	52.17%
12	Small	COBBLE	64 - 90	11		11	9.57%	61.74%
13	Small	COBBLE	90 - 128	14		14	12.17%	73.91%
14	Large	COBBLE	128 - 180	12		12	10.43%	84.35%
15	Large	COBBLE	180 - 256	4		4	3.48%	87.83%
16	Small	BOULDERS	256 - 362	9		9	7.83%	95.65%
17	Small	BOULDERS	362 - 512	3		3	2.61%	98.26%
18	Medium	BOULDERS	512 - 1024	2		2	1.74%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples				0	115	100%	

SUBSTRATE DEQ/MDM

Date: 15 Sept.03 **Site Visit Code:** Profile #1 lower limit

Waterbody: SF Coal Cr. **STORET Station ID:** 0690779 / 5394257

Personnel: djp, cll

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				0.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	3		3	2.83%	2.83%
2	Sand		1 - 2	2		2	1.89%	4.72%
3	Very Fine	GRAVELS	2 - 4	6		6	5.66%	10.38%
4	Fine	GRAVELS	4 - 6	6		6	5.66%	16.04%
5	Fine	GRAVELS	6 - 8	3		3	2.83%	18.87%
6	Medium	GRAVELS	8 - 12	10		10	9.43%	28.30%
7	Medium	GRAVELS	12 - 16	5		5	4.72%	33.02%
8	Coarse	GRAVELS	16 - 22	5		5	4.72%	37.74%
9	Coarse	GRAVELS	22 - 32	12		12	11.32%	49.06%
10	Very Coarse	GRAVELS	32 - 45	10		10	9.43%	58.49%
11	Very Coarse	GRAVELS	45 - 64	8		8	7.55%	66.04%
12	Small	COBBLES	64 - 90	8		8	7.55%	73.58%
13	Small	COBBLES	90 - 128	2		2	1.89%	75.47%
14	Large	COBBLES	128 - 180	15		15	14.15%	89.62%
15	Large	COBBLES	180 - 256	6		6	5.66%	95.28%
16	Small	BOULDERS	256 - 362	3		3	2.83%	98.11%
17	Small	BOULDERS	362 - 512	1		1	0.94%	99.06%
18	Medium	BOULDERS	512 - 1024			0	0.00%	99.06%
19	Large	BOULDERS	1024 - 2048			0	0.00%	99.06%
20	Bedrock	BOULDERS	> 2048	1		1	0.94%	100.00%
21	Total # Samples				0	106	100%	

South Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	0.935-1.035 30 June 1976	4.05-4.15 30 June 1976	7.13-7.23 13 July 1976	4.05-4.15 28 June 1979	0.0-0.31 15 Oct. 1985	0.31-1.13 15 Oct. 1985
Landform slope	4	3	3	6	6	2
Mass wasting	6	6	3	3	12	6
Debris jam potential	8	6	6	6	7	5
Vegetative bank protection	5	6	5	3	9	6
LOWER BANKS						
Channel capacity	2	1	2	2	3	1
Bank rock content	5	4	5	8	6	3
Obstructions/flow deflectors/sediment traps	6	3	4	2	8	3
Cutting	5	6	4	4	14	6
Deposition	6	4	4	8	12	6
BOTTOM						
Rock angularity	3	3	2	2	3	2
Brightness	3	2	2	1	4	2
Consolid or particle packing	4	4	4	4	6	3
Bottom size distribution / percent stable materials	8	8	8	4	12	6
Scouring and deposition	12	10	8	6	20	7
Clinging aquatic vegetation	3	3	2	2	4	3
TOTALS	**80**	**69**	**62**	**61**	**126**	**61**

Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

South Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	1.13-1.53 16 Oct. 1985	1.53-2.28 16 Oct. 1985	2.28-2.96 16 Oct. 1985	2.96-3.23 16 Oct. 1985	3.23-4.03 17 Oct.1985	4.03-5.15 17 Oct. 1985
Landform slope	4	2	6	6	4	8
Mass wasting	6	7	10	8	9	12
Debris jam potential	4	5	8	5	5	8
Vegetative bank protection	6	7	10	8	9	12
LOWER BANKS						
Channel capacity	2	2	3	2	2	1
Bank rock content	4	3	4	4	2	4
Obstructions/flow deflectors/sediment traps	3	4	8	4	4	8
Cutting	8	10	16	9	10	8
Deposition	7	8	14	8	12	16
BOTTOM						
Rock angularity	2	2	3	2	2	2
Brightness	3	3	4	3	3	3
Consolid or particle packing	3	5	7	4	5	5
Bottom size distribution / percent stable materials	6	10	14	10	9	12
Scouring and deposition	8	12	19	12	12	14
Clinging aquatic vegetation	3	4	4	4	3	3
TOTALS	**69**	**84**	**130**	**89**	**91**	**116**

Reach score for Rosgen "C1 and C2" channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen "C3 and C6" channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen "C4 and C5" channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

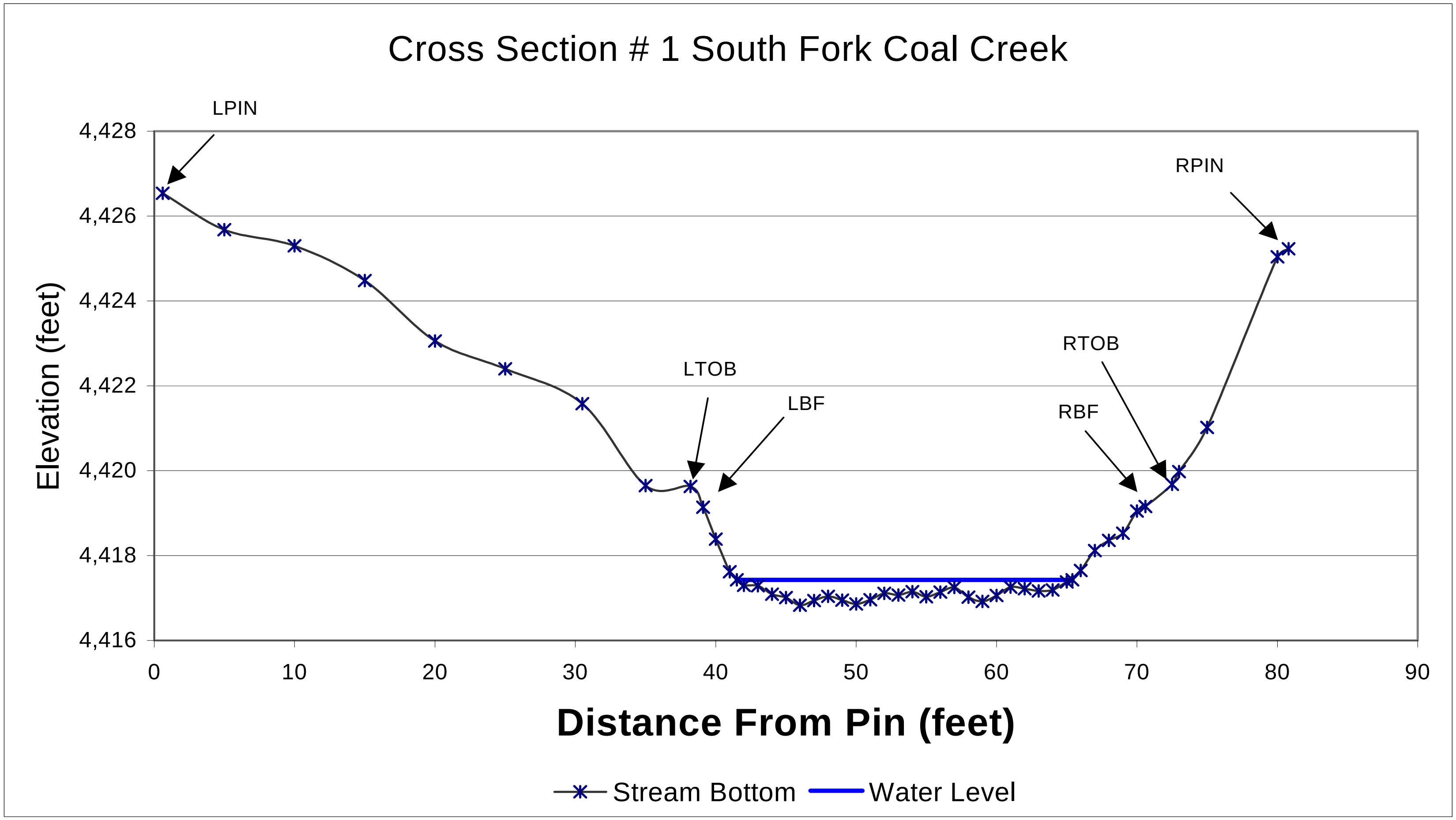
South Fork Coal Creek and Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	5.15-6.81 18 Oct. 1985	Mathias Cr 2.63-2.73 12 July 76	Profile #1 LL 15 Sept.03	Profile #1 CS 15 Sept. 03	Profile #1 UL 15 Sept. 03	Profile #2 LL 1 Oct. 03	Profile #2 CS 1 Oct. 03	Profile #2 UL 1 Oct. 03
Landform slope	5	2	2	2	2	2	3	4
Mass wasting	8	3	3	3	3	9	3	6
Debris jam potential	5	6	6	6	6	6	8	6
Vegetat bank protection	8	5	3	3	3	6	6	3
LOWER BANKS								
Channel capacity	2	1	1	2	2	2	2	4
Bank rock content	3	2	4	4	2	2	4	4
Obstruction/flow deflector/sediment traps	3	4	2	2	2	6	4	2
Cutting	8	5	8	4	4	12	12	8
Deposition	6	4	4	4	8	8	8	4
BOTTOM								
Rock angularity	2	2	2	2	2	2	2	2
Brightness	2	2	1	1	1	2	4	2
Consolid or part packing	4	4	2	2	2	4	4	2
Bottom size distribution / % stable materials	8	6	8	4	4	8	8	8
Scouring and deposition	10	12	6	6	6	12	12	12
Clinging aquatic vegetat	2	3	3	2	1	3	3	3

UPPER BANKS	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date
	5.15-6.81 18 Oct. 1985	Mathias Cr 2.63-2.73 12 July 76	Profile #1 LL 15 Sept.03	Profile #1 CS 15 Sept. 03	Profile #1 UL 15 Sept. 03	Profile #2 LL 1 Oct. 03	Profile #2 CS 1 Oct. 03	Profile #2 UL 1 Oct. 03
TOTALS	**76**	**61**	**55**	**47**	**48**	**84**	**86**	**70**

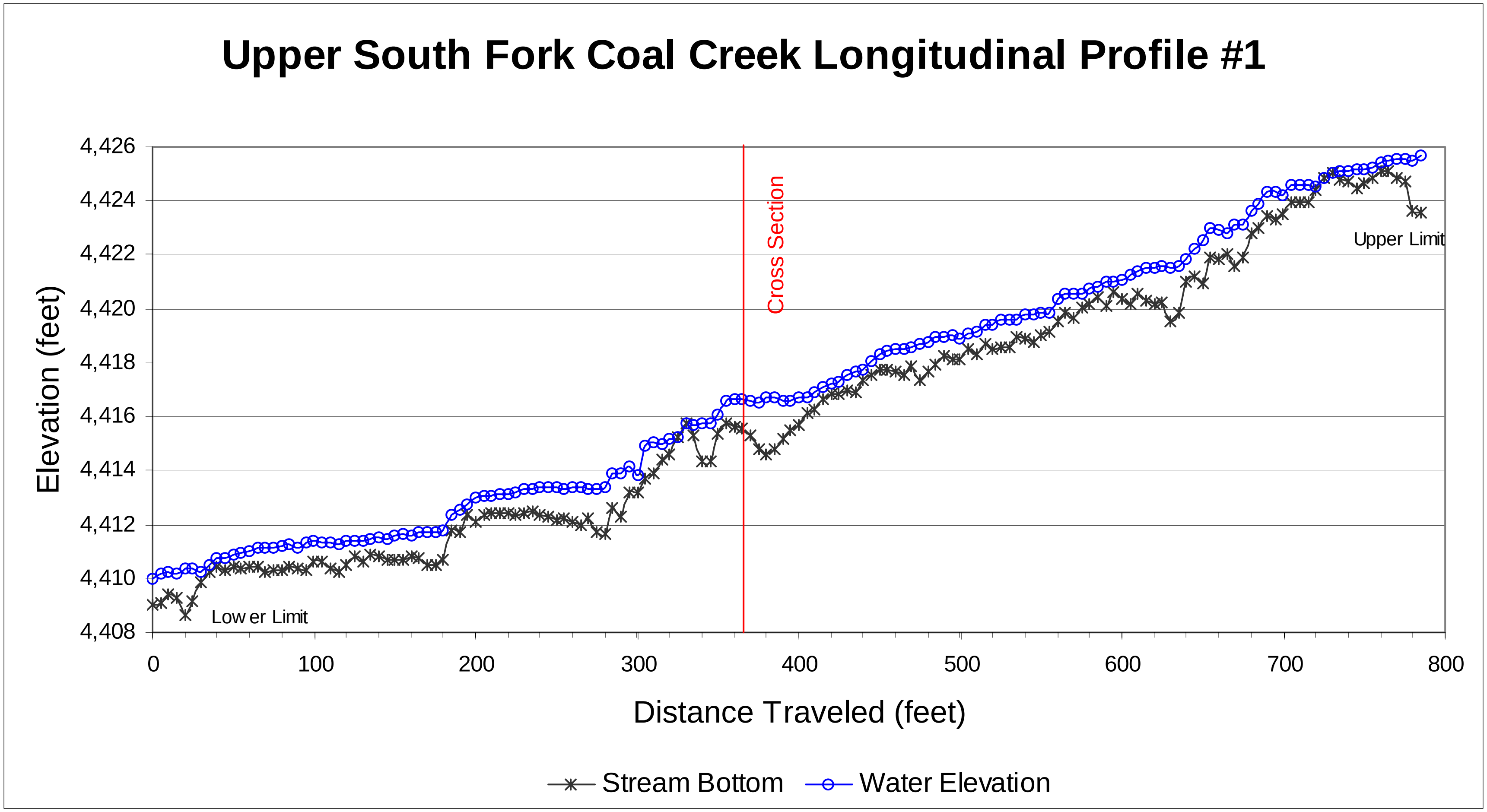
Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

Cross Section



EXCEL filename: Upper SF Coal Creek.xls
Vertical exaggeration = 13.3
Data recorded looking downstream

Longitudinal Profile

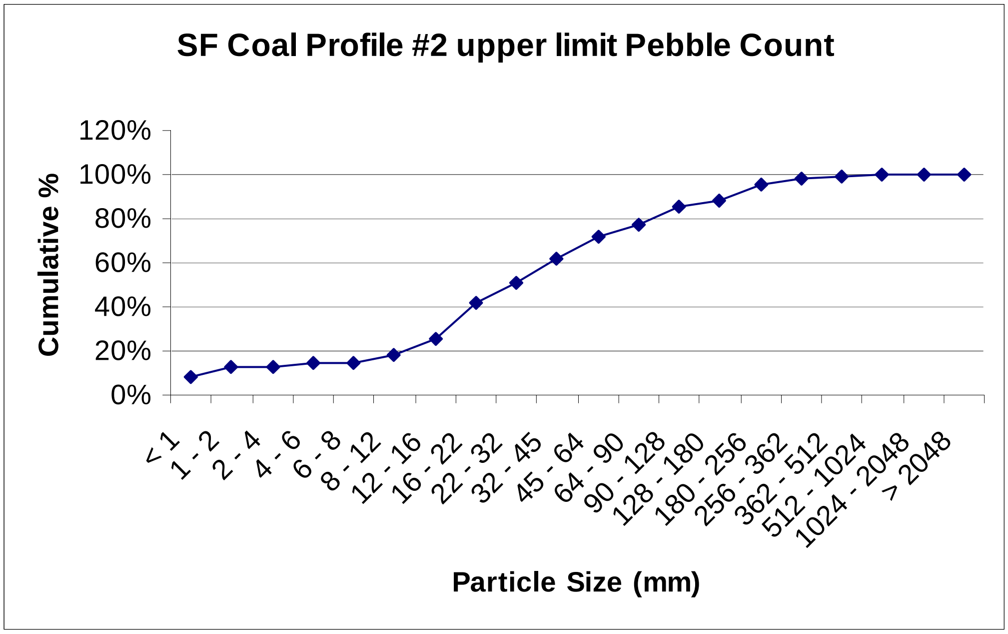


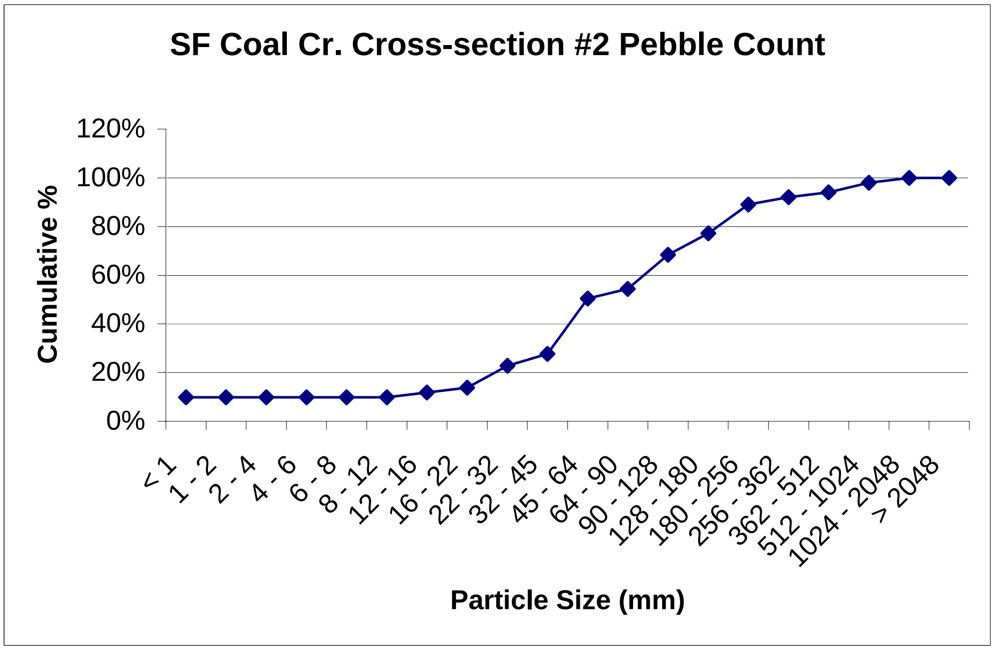
EXCEL filename: Upper SF Coal Creek.xls

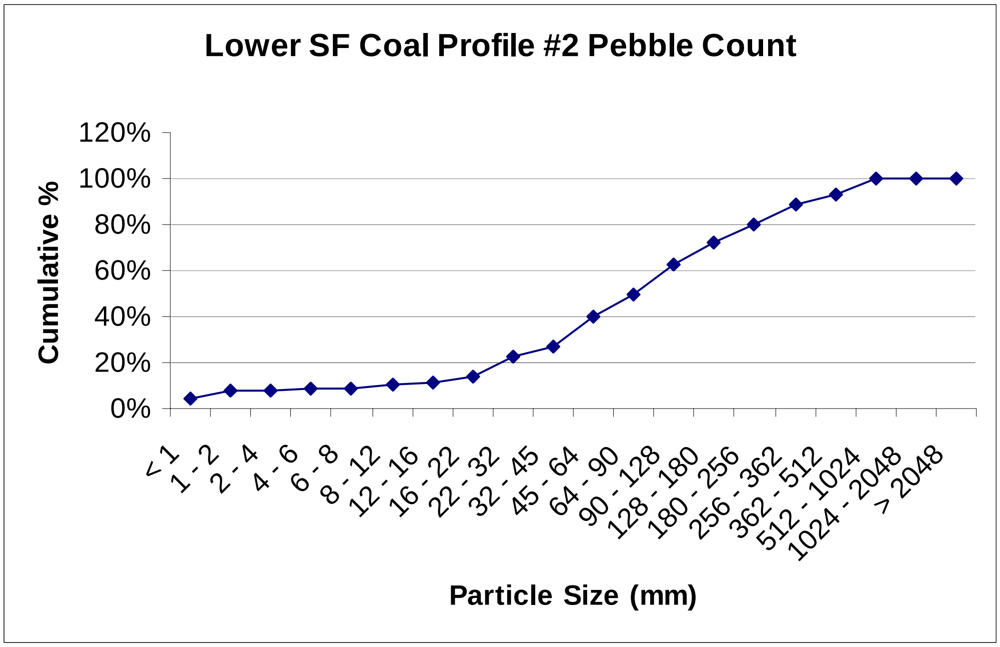
Vertical exaggeration = 2.3

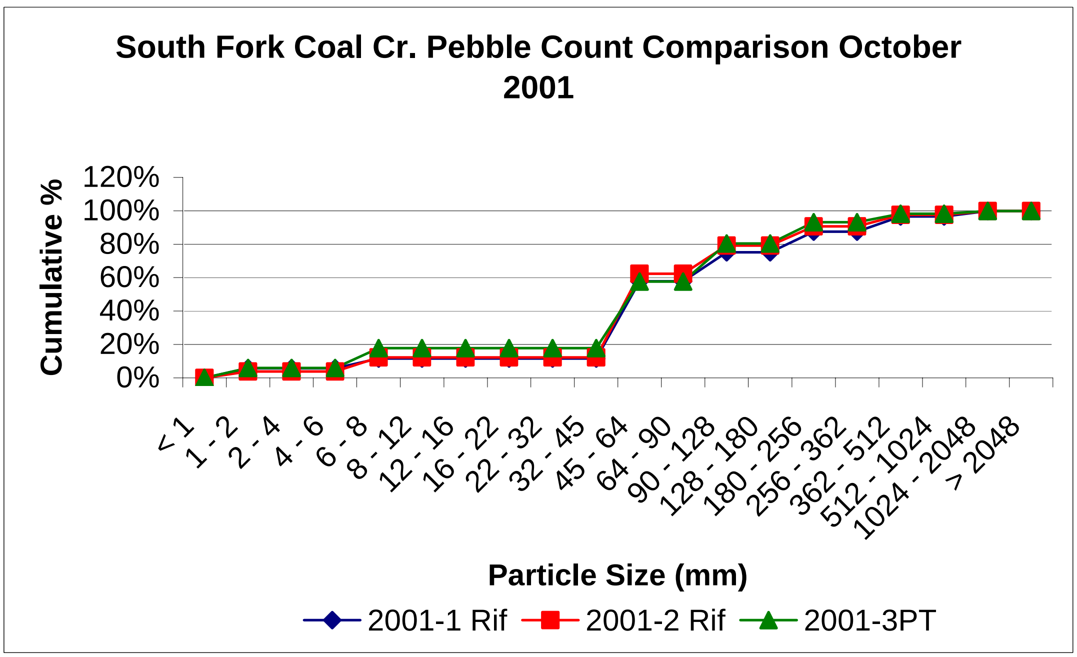
Lower South Fork Coal Creek

Pebble Counts

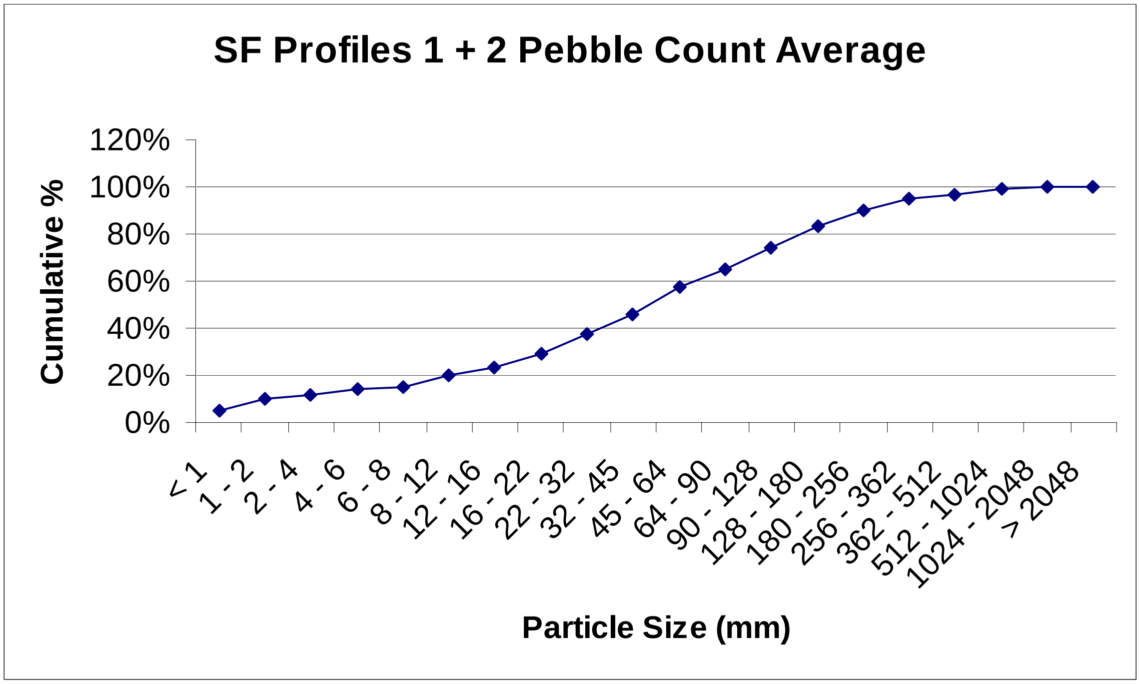








Historic pebble count comparison for unknown location on South Fork Coal Creek.



Average pebble counts from both profiles (6 sites) on South Fork Coal Creek.

SUBSTRATE DEQ/MDM								
Date:23 Sept.03				**Site Visit Code:**Profile #2 upper limit				
Waterbody:SF Coal Cr.Profile #2				**STORET Station ID:**0693790 / 539359				
Personnel:cll, jeg								
PEBBLE COUNT								
Row ID	**Particle Category**		**Size (mm)**	**Riffle Count**	**(Other) Count**	***Characteristic Group: PEBL-CNT***		
				0.00%	**0.00%**	**Sum**	**% of Total**	**Cum. Total**
1	**Silt / Clay**		**< 1**	**8**		**8**	7.77%	7.77%
2	**Sand**		**1 - 2**	**5**		**5**	4.85%	12.62%
3	**Very Fine**	**GRAVELS**	**2 - 4**			**0**	0.00%	12.62%
4	**Fine**		**4 - 6**	**2**		**2**	1.94%	14.56%
5	**Fine**		**6 - 8**			**0**	0.00%	14.56%
6	**Medium**		**8 - 12**	**4**		**4**	3.88%	18.45%
7	**Medium**		**12 - 16**	**7**		**7**	6.80%	25.24%
8	**Coarse**		**16 - 22**	**17**		**17**	16.50%	41.75%
9	**Coarse**		**22 - 32**	**9**		**9**	8.74%	50.49%
10	**Very Coarse**		**32 - 45**	**12**		**12**	11.65%	62.14%
11	**Very Coarse**		**45 - 64**	**10**		**10**	9.71%	71.84%
12	**Small**	**COBBLES**	**64 - 90**	**6**		**6**	5.83%	77.67%
13	**Small**		**90 - 128**	**8**		**8**	7.77%	85.44%
14	**Large**		**128 - 180**	**3**		**3**	2.91%	88.35%
15	**Large**		**180 - 256**	**7**		**7**	6.80%	95.15%
16	**Small**	**BOULDERS**	**256 - 362**	**3**		**3**	2.91%	98.06%
17	**Small**		**362 - 512**	**1**		**1**	0.97%	99.03%
18	**Medium**		**512 - 1024**	**1**		**1**	0.97%	100.00%
19	**Large**		**1024 - 2048**			**0**	0.00%	100.00%
20	**Bedrock**		**> 2048**			**0**	0.00%	100.00%
21	**Total # Samples**				**0**	**103**	**100%**	

SUBSTRATE DEQ/MDM

Date: 1 Ocr. 03 **Site Visit Code:** cross-section #2

Waterbody: SF Coal Cr. Profile #2 **STORET Station ID:** 0693941 / 5395371

Personnel: cll,jeg,hh

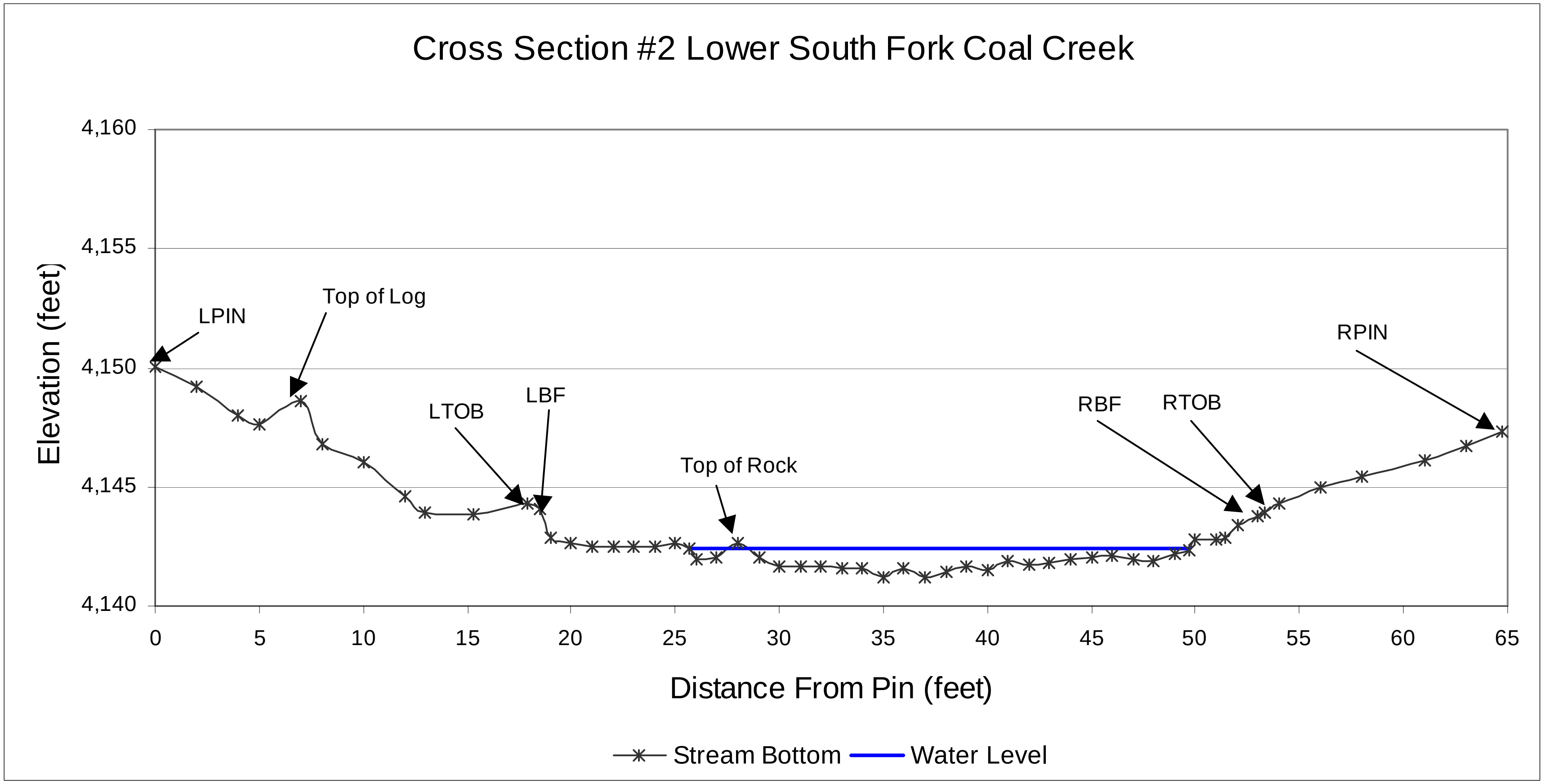
PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				0.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	10		10	9.90%	9.90%
2	Sand		1 - 2			0	0.00%	9.90%
3	Very Fine	GRAVELS	2 - 4			0	0.00%	9.90%
4	Fine	GRAVELS	4 - 6			0	0.00%	9.90%
5	Fine	GRAVELS	6 - 8			0	0.00%	9.90%
6	Medium	GRAVELS	8 - 12			0	0.00%	9.90%
7	Medium	GRAVELS	12 - 16	2		2	1.98%	11.88%
8	Coarse	GRAVELS	16 - 22	2		2	1.98%	13.86%
9	Coarse	GRAVELS	22 - 32	9		9	8.91%	22.77%
10	Very Coarse	GRAVELS	32 - 45	5		5	4.95%	27.72%
11	Very Coarse	GRAVELS	45 - 64	23		23	22.77%	50.50%
12	Small	COBBLES	64 - 90	4		4	3.96%	54.46%
13	Small	COBBLES	90 - 128	14		14	13.86%	68.32%
14	Large	COBBLES	128 - 180	9		9	8.91%	77.23%
15	Large	COBBLES	180 - 256	12		12	11.88%	89.11%
16	Small	BOULDERS	256 - 362	3		3	2.97%	92.08%
17	Small	BOULDERS	362 - 512	2		2	1.98%	94.06%
18	Medium	BOULDERS	512 - 1024	4		4	3.96%	98.02%
19	Large	BOULDERS	1024 - 2048	2		2	1.98%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples				0	101	100%	

SUBSTRATE DEQ/MDM								
Date: 1 Oct. 03				**Site Visit Code:** Profile #2 lower limit				
Waterbody: SF Coal Cr.profile 2				**STORET Station ID:** 0694027 / 5395376				
Personnel: cll, jeg, hh								
PEBBLE COUNT								
Row ID	**Particle Category**		**Size (mm)**	**Riffle Count**	**(Other) Count**	***Characteristic Group: PEBL-CNT***		
				0.00%	**0.00%**	**Sum**	**% of Total**	**Cum. Total**
1	**Silt / Clay**		**< 1**	**5**		**5**	4.35%	4.35%
2	**Sand**		**1 - 2**	**4**		**4**	3.48%	7.83%
3	**Very Fine**	**GRAVELS**	**2 - 4**			**0**	0.00%	7.83%
4	**Fine**	**GRAVELS**	**4 - 6**	**1**		**1**	0.87%	8.70%
5	**Fine**	**GRAVELS**	**6 - 8**			**0**	0.00%	8.70%
6	**Medium**	**GRAVELS**	**8 - 12**	**2**		**2**	1.74%	10.43%
7	**Medium**	**GRAVELS**	**12 - 16**	**1**		**1**	0.87%	11.30%
8	**Coarse**	**GRAVELS**	**16 - 22**	**3**		**3**	2.61%	13.91%
9	**Coarse**	**GRAVELS**	**22 - 32**	**10**		**10**	8.70%	22.61%
10	**Very Coarse**	**GRAVELS**	**32 - 45**	**5**		**5**	4.35%	26.96%
11	**Very Coarse**	**GRAVELS**	**45 - 64**	**15**		**15**	13.04%	40.00%
12	**Small**	**COBBLES**	**64 - 90**	**11**		**11**	9.57%	49.57%
13	**Small**	**COBBLES**	**90 - 128**	**15**		**15**	13.04%	62.61%
14	**Large**	**COBBLES**	**128 - 180**	**11**		**11**	9.57%	72.17%
15	**Large**	**COBBLES**	**180 - 256**	**9**		**9**	7.83%	80.00%
16	**Small**	**BOULDERS**	**256 - 362**	**10**		**10**	8.70%	88.70%
17	**Small**	**BOULDERS**	**362 - 512**	**5**		**5**	4.35%	93.04%
18	**Medium**	**BOULDERS**	**512 - 1024**	**8**		**8**	6.96%	100.00%
19	**Large**	**BOULDERS**	**1024 - 2048**			**0**	0.00%	100.00%
20	**Bedrock**	**BOULDERS**	**> 2048**			**0**	0.00%	100.00%
21	**Total # Samples**				**0**	**115**	**100%**	

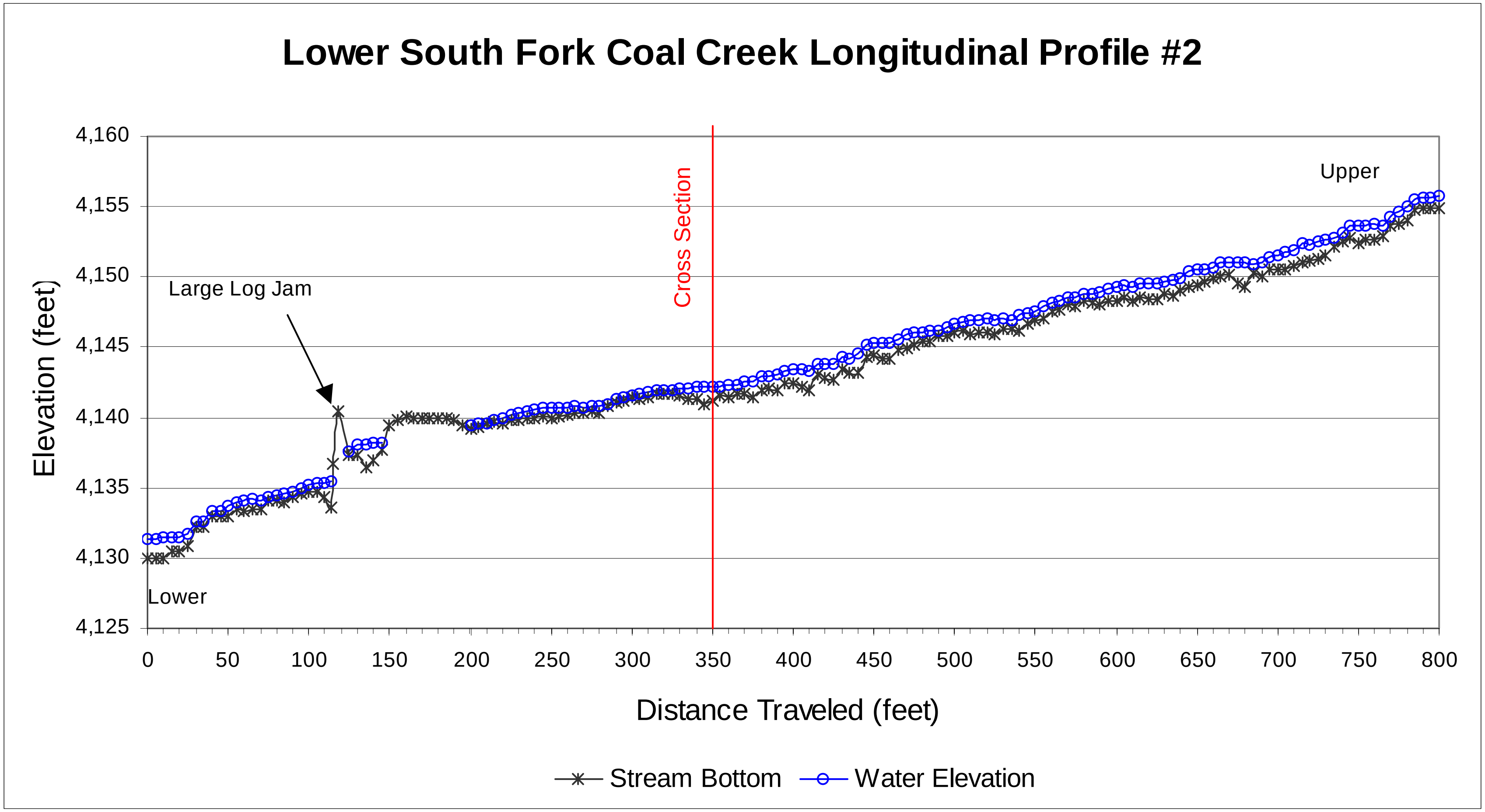
SUBSTRATE DEQ/MDM								
Date: 3-Oct-01			**Site Visit Code:** stream I.D. = 1030003					
Waterbody: SF Coal Cr.			**STORET Station ID:** station I.D. = 2001-1 riffle					
Personnel: Unknown but probably Linda, Roger and Rick								
PEBBLE COUNT								
Row ID	**Particle Category**		**Size (mm)**	**Riffle Count**	**(Other) Count**	***Characteristic Group: PEBL-CNT***		
				100%	**0.00%**	**Sum**	**% of Total**	**Cum. Total**
1	**Silt / Clay**		**< 1**			**0**	0.00%	0.00%
2	**Sand**		**1 - 2**	**7**		**7**	5.79%	5.79%
3	**Very Fine**	**GRAVELS**	**2 - 4**			**0**	0.00%	5.79%
4	**Fine**	**GRAVELS**	**4 - 6**			**0**	0.00%	5.79%
5	**Fine**	**GRAVELS**	**6 - 8**	**7**		**7**	5.79%	11.57%
6	**Medium**	**GRAVELS**	**8 - 12**			**0**	0.00%	11.57%
7	**Medium**	**GRAVELS**	**12 - 16**			**0**	0.00%	11.57%
8	**Coarse**	**GRAVELS**	**16 - 22**			**0**	0.00%	11.57%
9	**Coarse**	**GRAVELS**	**22 - 32**			**0**	0.00%	11.57%
10	**Very Coarse**	**GRAVELS**	**32 - 45**			**0**	0.00%	11.57%
11	**Very Coarse**	**GRAVELS**	**45 - 64**	**56**		**56**	46.28%	57.85%
12	**Small**	**COBBLES**	**64 - 90**			**0**	0.00%	57.85%
13	**Small**	**COBBLES**	**90 - 128**	**21**		**21**	17.36%	75.21%
14	**Large**	**COBBLES**	**128 - 180**			**0**	0.00%	75.21%
15	**Large**	**COBBLES**	**180 - 256**	**15**		**15**	12.40%	87.60%
16	**Small**	**BOULDERS**	**256 - 362**			**0**	0.00%	87.60%
17	**Small**	**BOULDERS**	**362 - 512**	**11**		**11**	9.09%	96.69%
18	**Medium**	**BOULDERS**	**512 - 1024**			**0**	0.00%	96.69%
19	**Large**	**BOULDERS**	**1024 - 2048**	**4**		**4**	3.31%	100.00%
20	**Bedrock**	**BOULDERS**	**> 2048**			**0**	0.00%	100.00%
21	**Total # Samples**			**121**	**0**	**121**	**100%**	

Cross Section



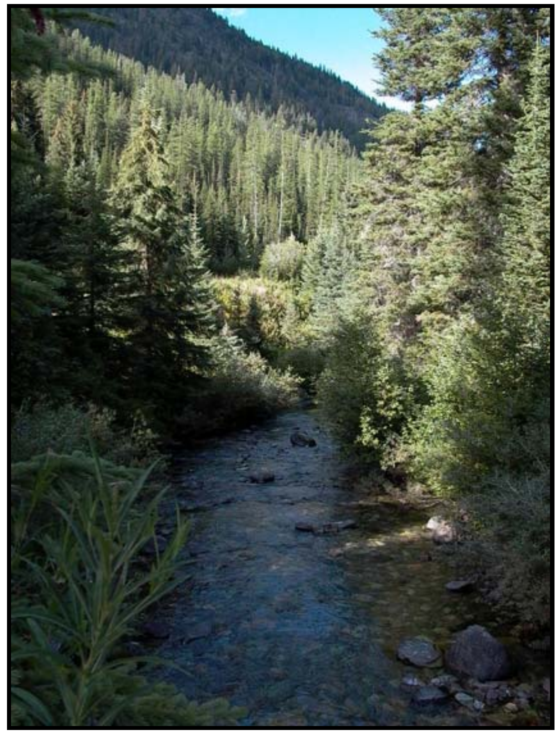
EXCEL filename: Lower SF Coal Creek.xls
Vertical exaggeration = 30.8
Data recorded looking downstream

Longitudinal Profile #2



EXCEL filename: Lower SF Coal Creek.xls
Vertical exaggeration = 4.4

North Fork Coal

Site Visit Form

Place Site Visit Label Here

03-0935

Site Visit Form
(One Station per page)

STORET Project ID: TMDL- C06.
Trip ID: 2003-FLTHD Date: 6/27/03
Personnel: Laidlaw /Pridmore

Waterbody Name North Fork Coal County Flathead HUC 17010206
Station ID C06COLNC01 Visit # 1 Location Above confluence with S Fork
Lat 48.69178 Long 114.37678 Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale?

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0935M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 18:15	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

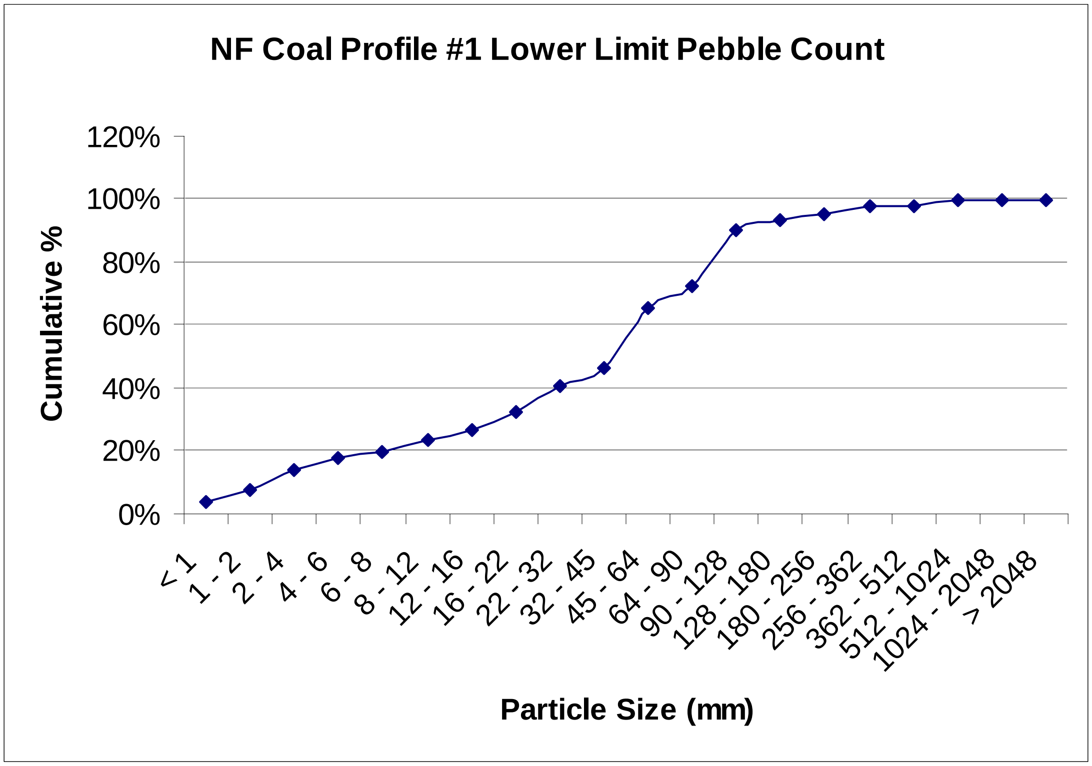
Macroinvertebrate Kick Duration: 12 min 45sec Kick Length (Ft.): 125'

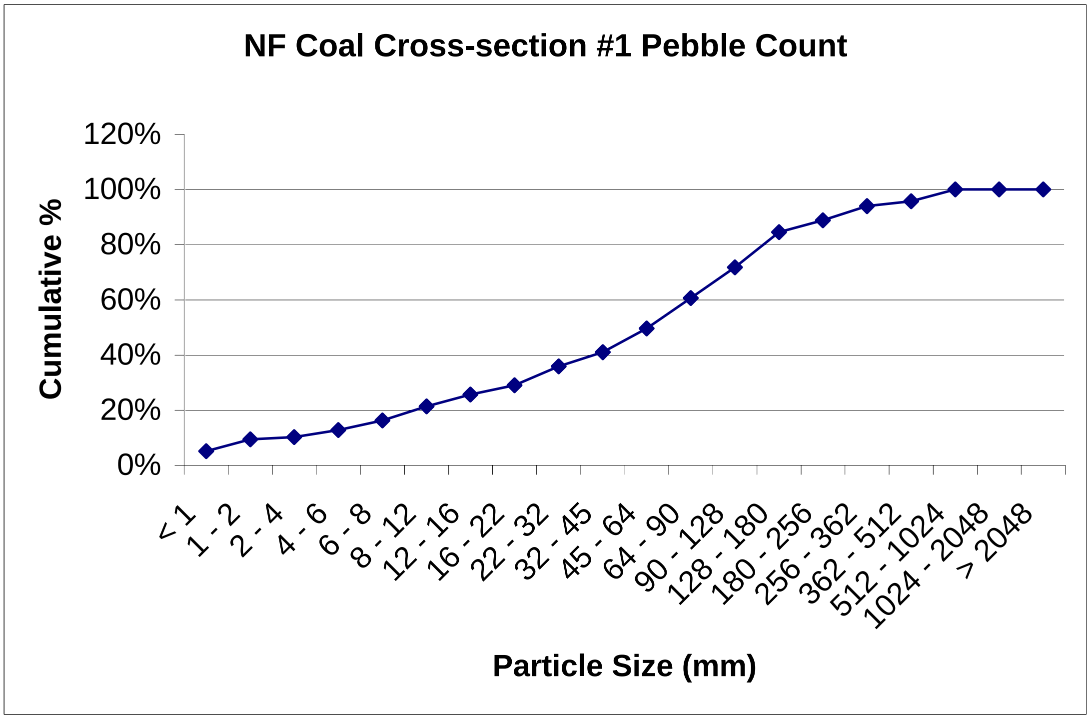
Site Visit Comments:

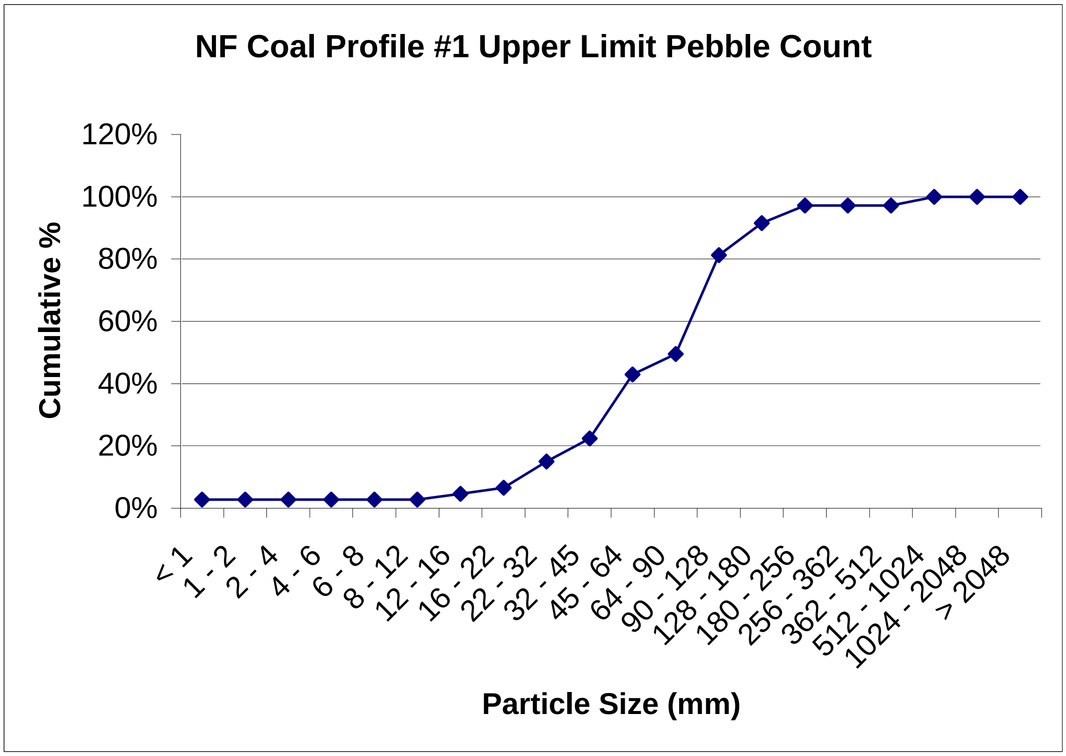
- large boulder/cobble
- some green filamentous algae + "mud puppies" present - small amt
- cascade, deep pools, riffles
- densely vegetated extensive riparian
- upstream from FS Rd Bridge on FS 317
- lots of mixed veg - willow, fir, larch

North Fork Coal Creek #1

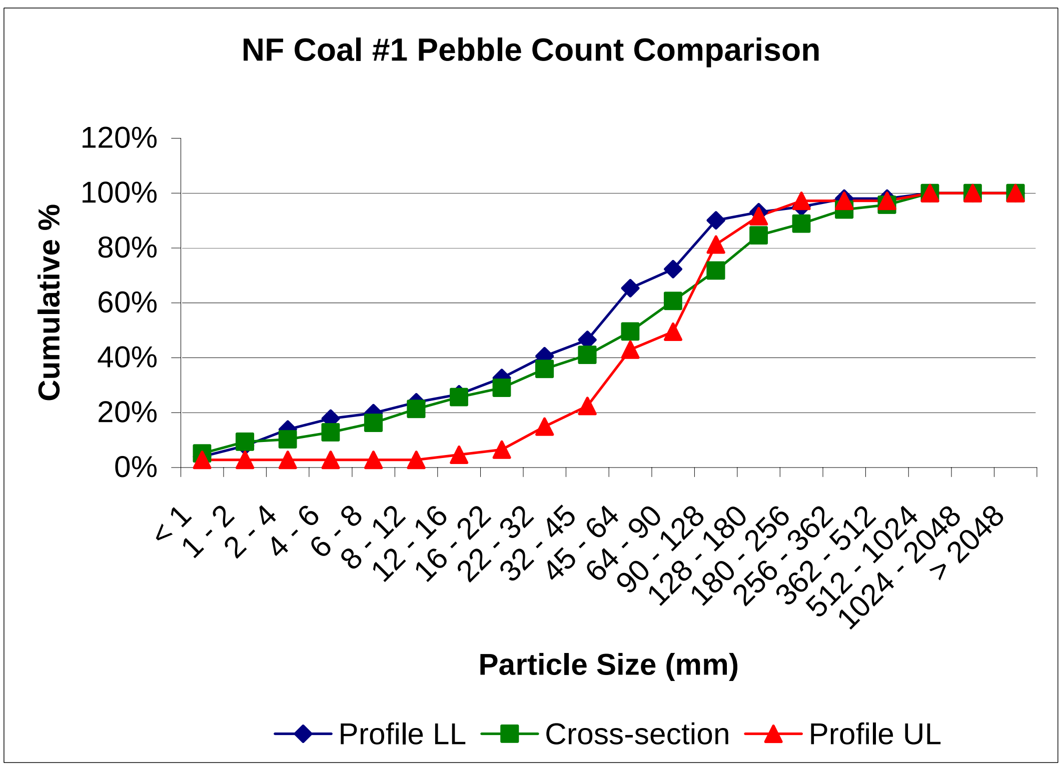
Pebble Counts







NF Coal Profile #1 Upper Limit Pebble Count
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)



NF Coal #1 Pebble Count Comparison
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Profile LL
Cross-section
Profile UL

SUBSTRATE DEQ/MDM

Date: 2 Oct. 2003 **Site Visit Code:** Profile #1 lower limit

Waterbody: NF Coal #1 **STORET Station ID:** 0687043 / 5397684

Personnel: jg,cl,hh

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	4		4	3.96%	3.96%
2	Sand		1 - 2	4		4	3.96%	7.92%
3	Very Fine	GRAVELS	2 - 4	6		6	5.94%	13.86%
4	Fine	GRAVELS	4 - 6	4		4	3.96%	17.82%
5	Fine	GRAVELS	6 - 8	2		2	1.98%	19.80%
6	Medium	GRAVELS	8 - 12	4		4	3.96%	23.76%
7	Medium	GRAVELS	12 - 16	3		3	2.97%	26.73%
8	Coarse	GRAVELS	16 - 22	6		6	5.94%	32.67%
9	Coarse	GRAVELS	22 - 32	8		8	7.92%	40.59%
10	Very Coarse	GRAVELS	32 - 45	6		6	5.94%	46.53%
11	Very Coarse	GRAVELS	45 - 64	19		19	18.81%	65.35%
12	Small	COBBLES	64 - 90	7		7	6.93%	72.28%
13	Small	COBBLES	90 - 128	18		18	17.82%	90.10%
14	Large	COBBLES	128 - 180	3		3	2.97%	93.07%
15	Large	COBBLES	180 - 256	2		2	1.98%	95.05%
16	Small	BOULDERS	256 - 362	3		3	2.97%	98.02%
17	Small	BOULDERS	362 - 512			0	0.00%	98.02%
18	Medium	BOULDERS	512 - 1024	2		2	1.98%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			101	0	101	100.00%	

SUBSTRATE DEQ/MDM

Date: 2 Oct. 2003 **Site Visit Code:** cross-section#1

Waterbody: NF Coal #1 **STORET Station ID:** 0686952 /5397691

Personnel: jg,cl,hh

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	6		6	5.13%	5.13%
2	Sand		1 - 2	5		5	4.27%	9.40%
3	Very Fine	GRAVELS	2 - 4	1		1	0.85%	10.26%
4	Fine	GRAVELS	4 - 6	3		3	2.56%	12.82%
5	Fine	GRAVELS	6 - 8	4		4	3.42%	16.24%
6	Medium	GRAVELS	8 - 12	6		6	5.13%	21.37%
7	Medium	GRAVELS	12 - 16	5		5	4.27%	25.64%
8	Coarse	GRAVELS	16 - 22	4		4	3.42%	29.06%
9	Coarse	GRAVELS	22 - 32	8		8	6.84%	35.90%
10	Very Coarse	GRAVELS	32 - 45	6		6	5.13%	41.03%
11	Very Coarse	GRAVELS	45 - 64	10		10	8.55%	49.57%
12	Small	COBBLES	64 - 90	13		13	11.11%	60.68%
13	Small	COBBLES	90 - 128	13		13	11.11%	71.79%
14	Large	COBBLES	128 - 180	15		15	12.82%	84.62%
15	Large	COBBLES	180 - 256	5		5	4.27%	88.89%
16	Small	BOULDERS	256 - 362	6		6	5.13%	94.02%
17	Small	BOULDERS	362 - 512	2		2	1.71%	95.73%
18	Medium	BOULDERS	512 - 1024	5		5	4.27%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			117	0	117	100.00%	

SUBSTRATE DEQ/MDM

Date: 2 Oct. 2003 **Site Visit Code:** Profile #1 upper limit

Waterbody: NF Coal #1 **STORET Station ID:** 0686886 / 5397655

Personnel: jg,cl,hh

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	3		3	2.80%	2.80%
2	Sand		1 - 2			0	0.00%	2.80%
3	Very Fine	GRAVELS	2 - 4			0	0.00%	2.80%
4	Fine	GRAVELS	4 - 6			0	0.00%	2.80%
5	Fine	GRAVELS	6 - 8			0	0.00%	2.80%
6	Medium	GRAVELS	8 - 12			0	0.00%	2.80%
7	Medium	GRAVELS	12 - 16	2		2	1.87%	4.67%
8	Coarse	GRAVELS	16 - 22	2		2	1.87%	6.54%
9	Coarse	GRAVELS	22 - 32	9		9	8.41%	14.95%
10	Very Coarse	GRAVELS	32 - 45	8		8	7.48%	22.43%
11	Very Coarse	GRAVELS	45 - 64	22		22	20.56%	42.99%
12	Small	COBBLES	64 - 90	7		7	6.54%	49.53%
13	Small	COBBLES	90 - 128	34		34	31.78%	81.31%
14	Large	COBBLES	128 - 180	11		11	10.28%	91.59%
15	Large	COBBLES	180 - 256	6		6	5.61%	97.20%
16	Small	BOULDERS	256 - 362			0	0.00%	97.20%
17	Small	BOULDERS	362 - 512			0	0.00%	97.20%
18	Medium	BOULDERS	512 - 1024	3		3	2.80%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			107	0	107	100.00%	

North Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	North Fork 12.18-12.28 30 June 1976	North Fork 16.19-16.29 13 July 1976	North Fork 18.57-18.67 13 July 1976	North Fork 20.22-20.32 13 July 1976	North Fork 12.18-12.28 27 June 1979	North Fork 16.19-16.29 27 June 1979
Landform slope	4	6	3	2	6	4
Mass wasting	3	7	5	3	3	3
Debris jam potential	6	6	8	7	6	4
Vegetative bank protection	5	6	5	4	9	9
LOWER BANKS						
Channel capacity	1	1	1	2	1	2
Bank rock content	4	4	2	6	4	0
Obstructions/flow deflectors/sediment traps	2	4	4	6	2	2
Cutting	6	8	6	8	8	8
Deposition	4	6	4	6	4	8
BOTTOM						
Rock angularity	2	2	2	2	2	2
Brightness	2	2	3	3	1	1
Consolid or particle packing	2	4	4	4	2	4
Bottom size distribution / percent stable materials	8	8	8	8	4	4
Scouring and deposition	12	10	12	12	6	12
Clinging aquatic vegetation	3	3	2	0	2	2
TOTALS	**64**	**77**	**69**	**75**	**60**	**65**

Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

North Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	North Fork 18.57-18.67 27 June 1979	North Fork 20.22-20.32 29 June 1979	North Fork 9.47-9.72 11 Oct. 1985	North Fork 9.72-9.95 11 Oct. 1985	North Fork 9.95-10.26 11 Oct. 1985
Landform slope	6	6	2	2	2
Mass wasting	3	3	6	12	12
Debris jam potential	2	5	5	6	8
Vegetative bank protection	3	6	6	8	9
LOWER BANKS					
Channel capacity	1	1	2	3	4
Bank rock content	2	6	6	2	6
Obstructions/flow deflectors/sediment traps	2	2	4	6	8
Cutting	4	8	10	16	16
Deposition	4	8	8	10	12
BOTTOM					
Rock angularity	2	2	2	3	2
Brightness	1	1	3	4	4
Consolid or particle packing	4	2	6	6	6
Bottom size distribution / percent stable materials	4	4	12	14	14
Scouring and deposition	6	6	12	18	18
Clinging aquatic vegetation	2	1	3	3	4
TOTALS	**46**	**61**	**89**	**113**	**125**

Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

North Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	North Fork 10.26-10.42 11 Oct. 1985	North Fork 10.42-10.91 12 Oct. 1985	North Fork 10.91-11.69 17 Oct. 1985	North Fork 11.69-12.84 21 Oct. 1985	North Fork 12.84-15.11 23 Oct. 1985	North Fork 15.11-16.25 23 Oct. 1985
Landform slope	4	2	8	2	4	4
Mass wasting	12	10	12	12	5	8
Debris jam potential	8	7	8	6	3	8
Vegetative bank protection	7	9	12	6	9	12
LOWER BANKS						
Channel capacity	3	3	1	3	1	4
Bank rock content	6	6	4	4	4	4
Obstructions/flow deflectors/sediment traps	5	7	8	7	4	8
Cutting	12	12	8	12	8	14
Deposition	8	10	16	12	8	12
BOTTOM						
Rock angularity	3	2	2	2	2	2
Brightness	3	3	3	3	3	3
Consolid or particle packing	6	5	5	5	4	4
Bottom size distribution / percent stable materials	8	12	12	12	8	12
Scouring and deposition	12	20	14	20	12	12
Clinging aquatic vegetation	4	3	3	3	3	4
TOTALS	**101**	**111**	**116**	**109**	**78**	**111**

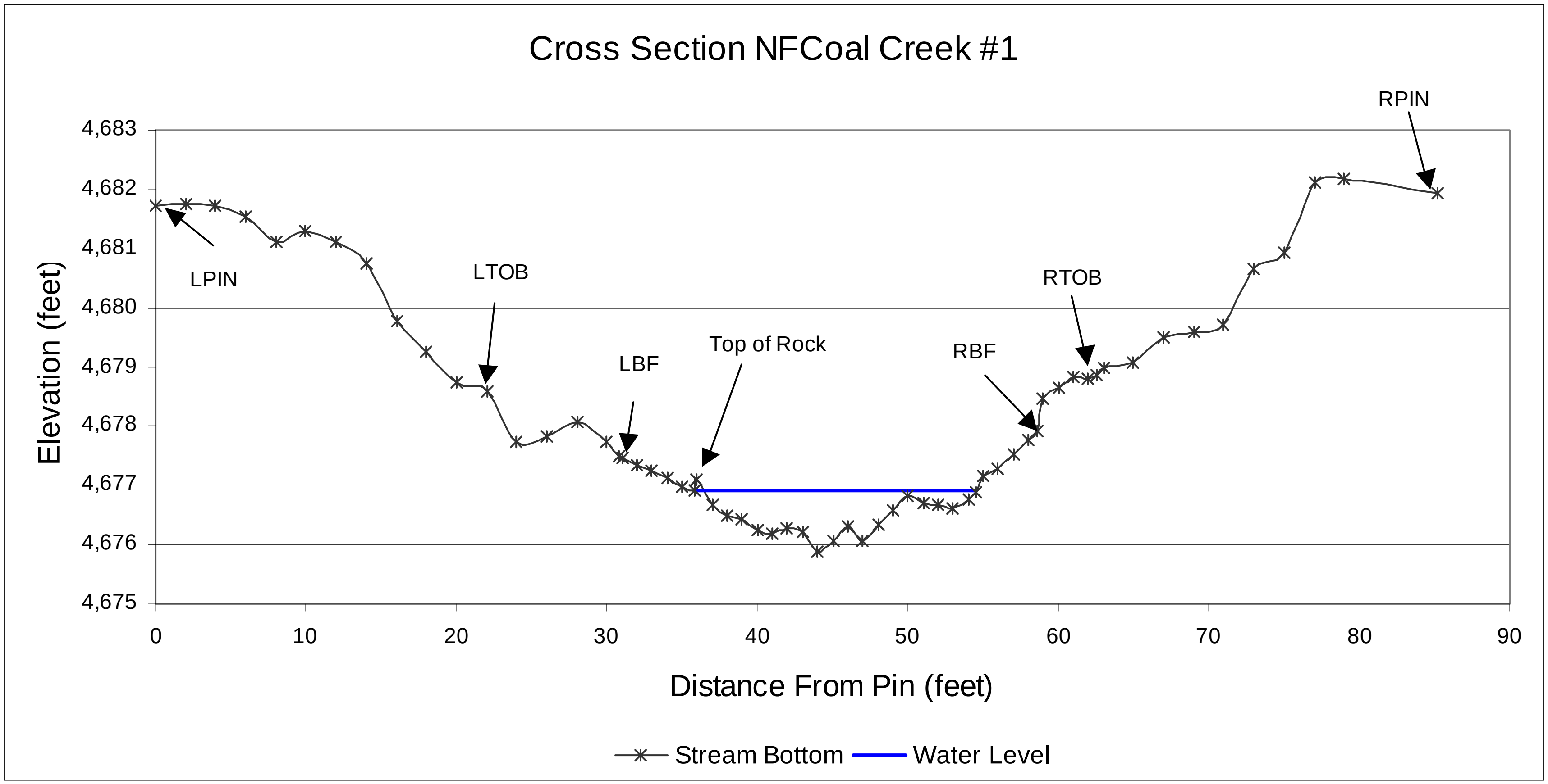
Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

North Fork Coal Creek Historic Pfankuch Rating Comparison

UPPER BANKS	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date	Stream segment Date
	NF Profile #1 UL 2 Oct. 2003	NF Profile #1 CS 2 Oct. 2003	NF Profile #1 LL 2 Oct. 2003	NF Profile #2 UL 8 Oct. 2003	NF Profile #2 CS 8 Oct. 2003	NF Profile #2 LL 8 Oct. 2003
Landform slope	4	6	4	6	4	4
Mass wasting	6	6	3	9	3	6
Debris jam potential	6	4	6	8	6	6
Vegetat bank protection	6	3	6	6	3	3
LOWER BANKS						
Channel capacity	2	1	2	3	2	1
Bank rock content	4	2	6	6	4	4
Obstructions/flow deflectors/sediment traps	4	4	6	6	4	8
Cutting	8	8	8	12	4	12
Deposition	12	8	8	8	4	8
BOTTOM						
Rock angularity	2	2	2	3	2	3
Brightness	2	2	3	3	3	3
Consolid or part packing	4	2	4	6	4	4
Bottom size distribution / percent stable materials	4	8	12	16	8	8
Scouring and deposition	12	12	12	18	6	18
Clinging aquatic vegetat	4	3	3	3	3	4
TOTALS	**80**	**73**	**85**	**113**	**60**	**92**

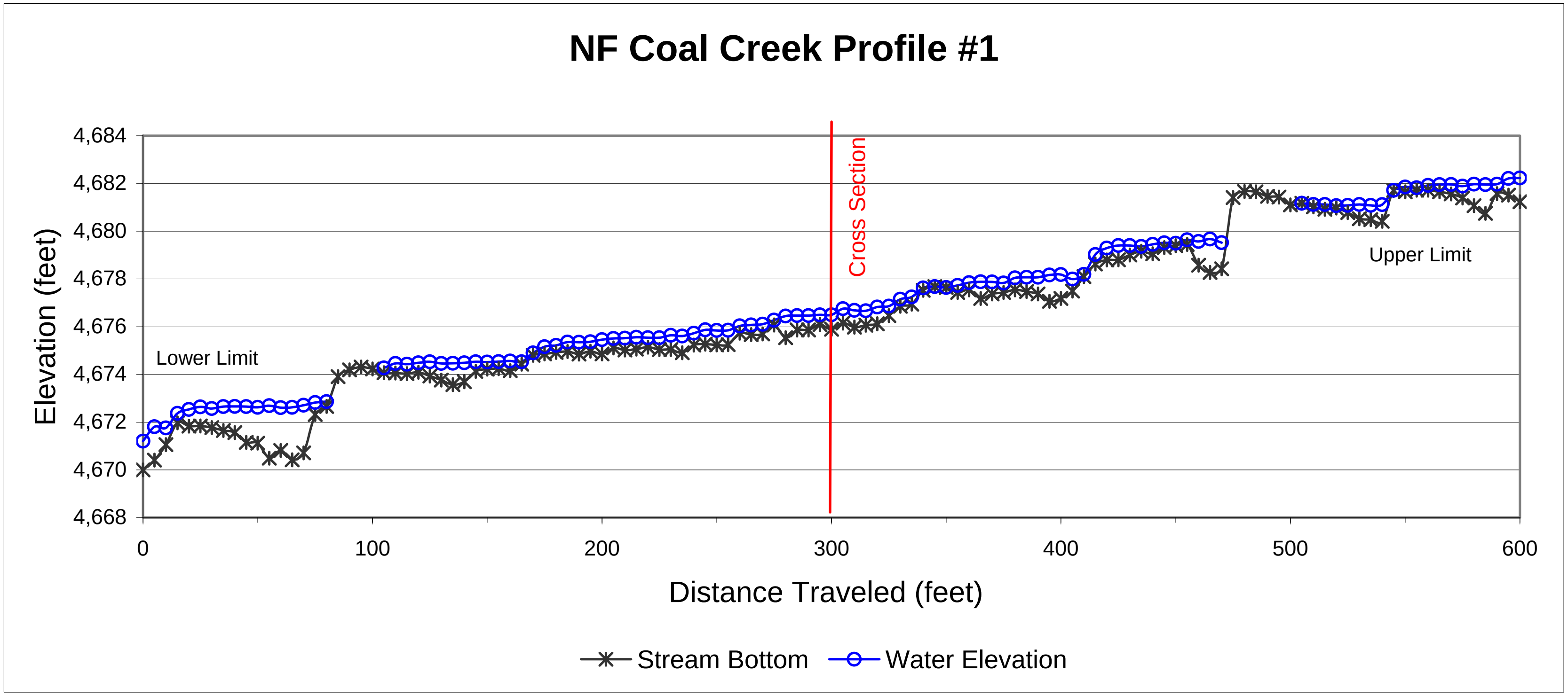
Reach score for Rosgen “C1 and C2” channel type : < 38 = Excellent; 39-43 = Good; 44-47 = Fair; >48 = Poor;
Rosgen “C3 and C6” channel type: < 59 = Excellent; 60-85 = Good; 86-105 = Fair; > 106 = Poor;
Rosgen “C4 and C5” channel type: < 69 = Excellent; 70-90 = Good; 91-110 = Fair; > 111 = Poor;

Cross Section



Data collected looking downstream.
EXCEL filename = NFCoal Cr.xls
Vertical exaggeration = 8.9

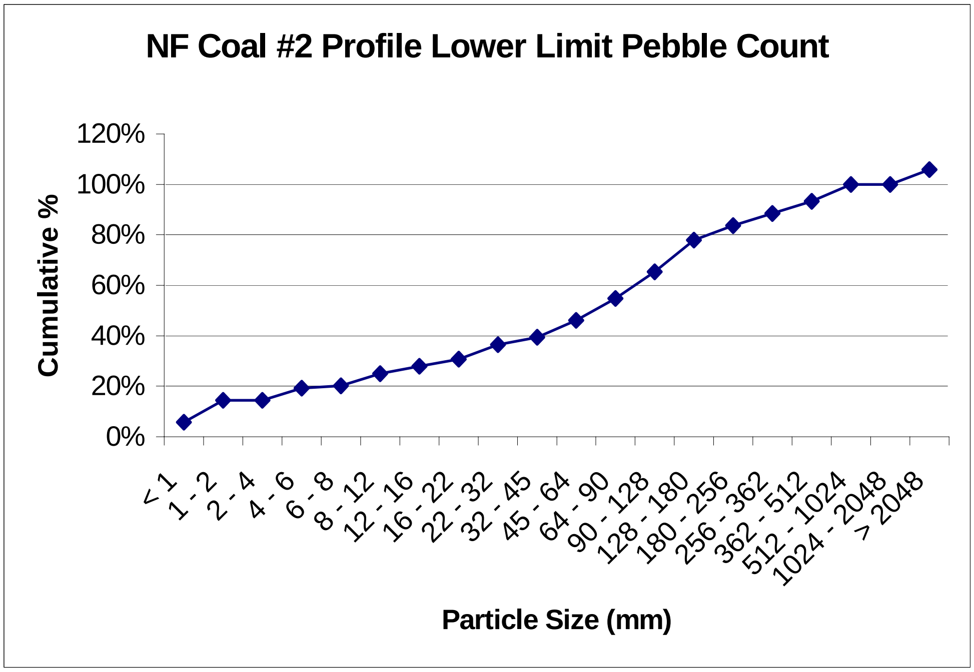
Longitudinal Profile

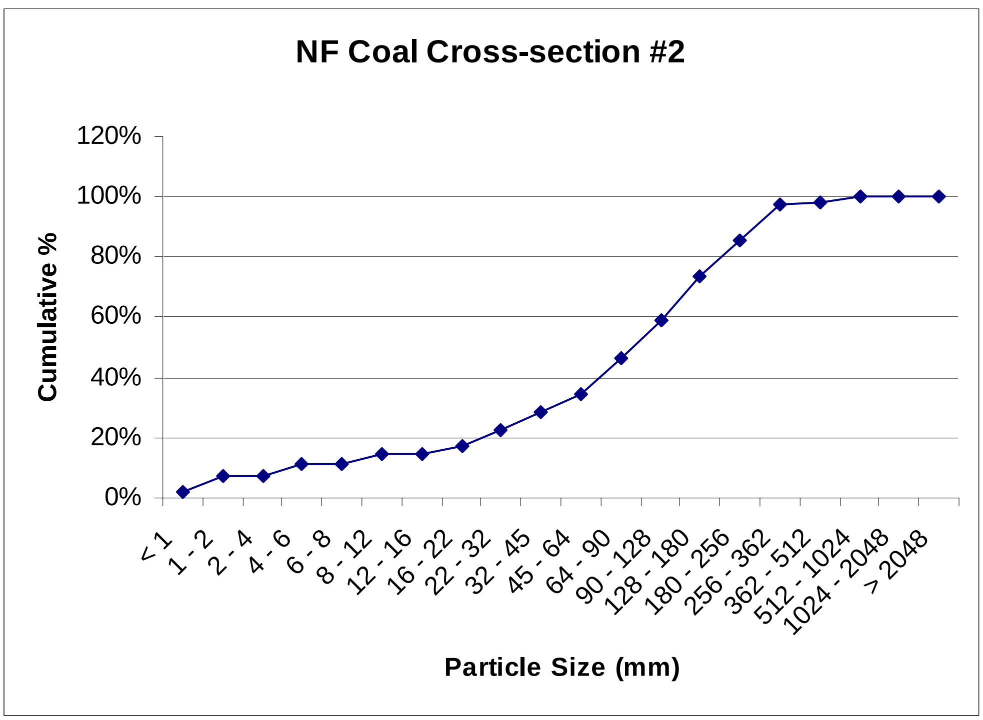


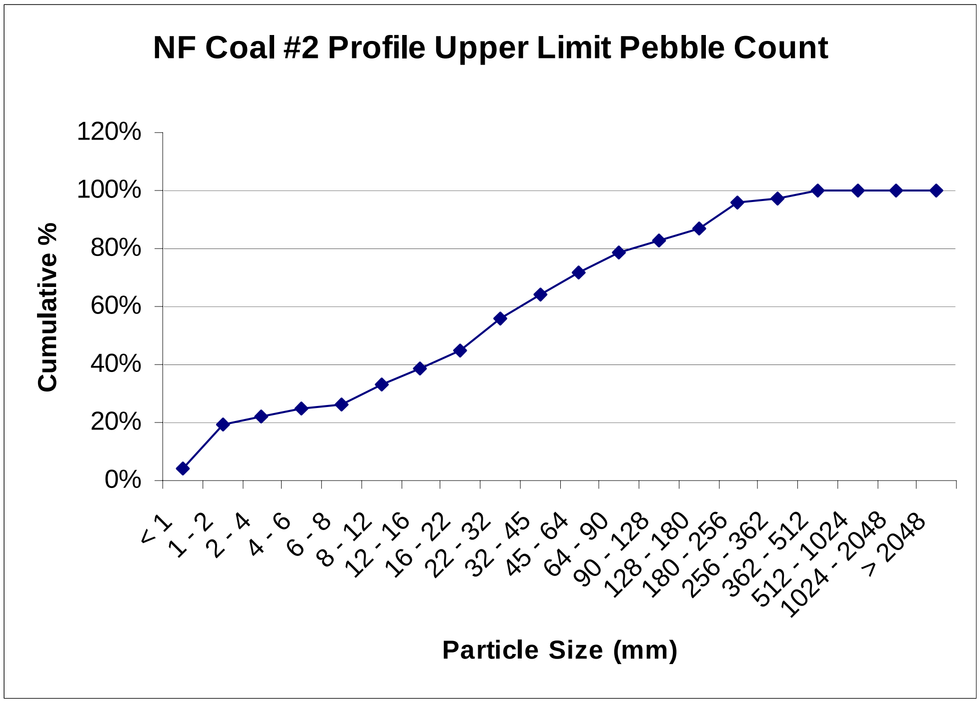
EXCEL filename = NFCoal Cr.xls
Vertical exaggeration = 2.7

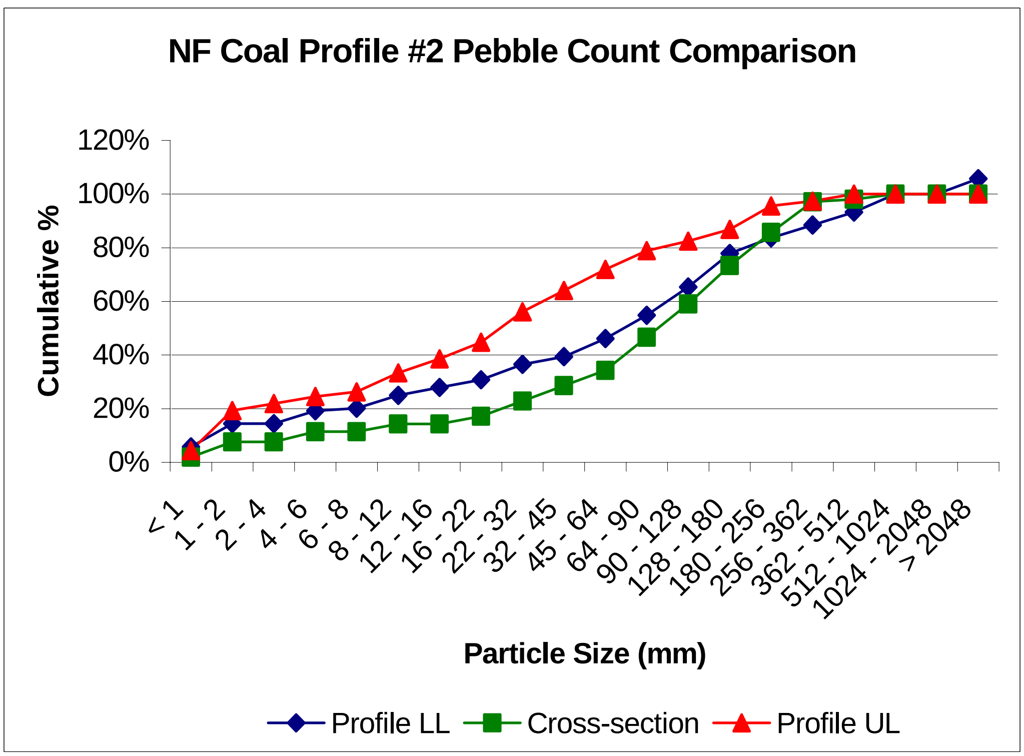
North Fork Coal Creek #2

Pebble Counts






NF Coal #2 Profile Upper Limit Pebble Count
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)


NF Coal Profile #2 Pebble Count Comparison
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Profile LL
Cross-section
Profile UL

SUBSTRATE DEQ/MDM

Date: 7 Oct. 2003 **Site Visit Code:** Profile#2 lower limit

Waterbody: NF Coal #2 **STORET Station ID:** 0692052 / 5396223

Personnel: jg, cl

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	6		6	5.77%	5.77%
2	Sand		1 - 2	9		9	8.65%	14.42%
3	Very Fine	GRAVELS	2 - 4			0	0.00%	14.42%
4	Fine	GRAVELS	4 - 6	5		5	4.81%	19.23%
5	Fine	GRAVELS	6 - 8	1		1	0.96%	20.19%
6	Medium	GRAVELS	8 - 12	5		5	4.81%	25.00%
7	Medium	GRAVELS	12 - 16	3		3	2.88%	27.88%
8	Coarse	GRAVELS	16 - 22	3		3	2.88%	30.77%
9	Coarse	GRAVELS	22 - 32	6		6	5.77%	36.54%
10	Very Coarse	GRAVELS	32 - 45	3		3	2.88%	39.42%
11	Very Coarse	GRAVELS	45 - 64	7		7	6.73%	46.15%
12	Small	COBBLES	64 - 90	9		9	8.65%	54.81%
13	Small	COBBLES	90 - 128	11		11	10.58%	65.38%
14	Large	COBBLES	128 - 180	13		13	12.50%	77.88%
15	Large	COBBLES	180 - 256	6		6	5.77%	83.65%
16	Small	BOULDERS	256 - 362	5		5	4.81%	88.46%
17	Small	BOULDERS	362 - 512	5		5	4.81%	93.27%
18	Medium	BOULDERS	512 - 1024	7		7	6.73%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			104	0	104	100.00%	

SUBSTRATE DEQ/MDM

Date: 7 Oct. 2003 **Site Visit Code:** cross-section #2

Waterbody: NF Coal #2 **STORET Station ID:** 0691960 / 5396224

Personnel: GRACE, LEWIS

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	2		2	1.90%	1.90%
2	Sand		1 - 2	6		6	5.71%	7.62%
3	Very Fine	GRAVELS	2 - 4			0	0.00%	7.62%
4	Fine	GRAVELS	4 - 6	4		4	3.81%	11.43%
5	Fine	GRAVELS	6 - 8			0	0.00%	11.43%
6	Medium	GRAVELS	8 - 12	3		3	2.86%	14.29%
7	Medium	GRAVELS	12 - 16			0	0.00%	14.29%
8	Coarse	GRAVELS	16 - 22	3		3	2.86%	17.14%
9	Coarse	GRAVELS	22 - 32	6		6	5.71%	22.86%
10	Very Coarse	GRAVELS	32 - 45	6		6	5.71%	28.57%
11	Very Coarse	GRAVELS	45 - 64	6		6	5.71%	34.29%
12	Small	COBBLES	64 - 90	13		13	12.38%	46.67%
13	Small	COBBLES	90 - 128	13		13	12.38%	59.05%
14	Large	COBBLES	128 - 180	15		15	14.29%	73.33%
15	Large	COBBLES	180 - 256	13		13	12.38%	85.71%
16	Small	BOULDERS	256 - 362	12		12	11.43%	97.14%
17	Small	BOULDERS	362 - 512	1		1	0.95%	98.10%
18	Medium	BOULDERS	512 - 1024	2		2	1.90%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			105	0	105	100.00%	

SUBSTRATE DEQ/MDM

Date: 7 Oct. 2003 **Site Visit Code:** Profile #2upper limit

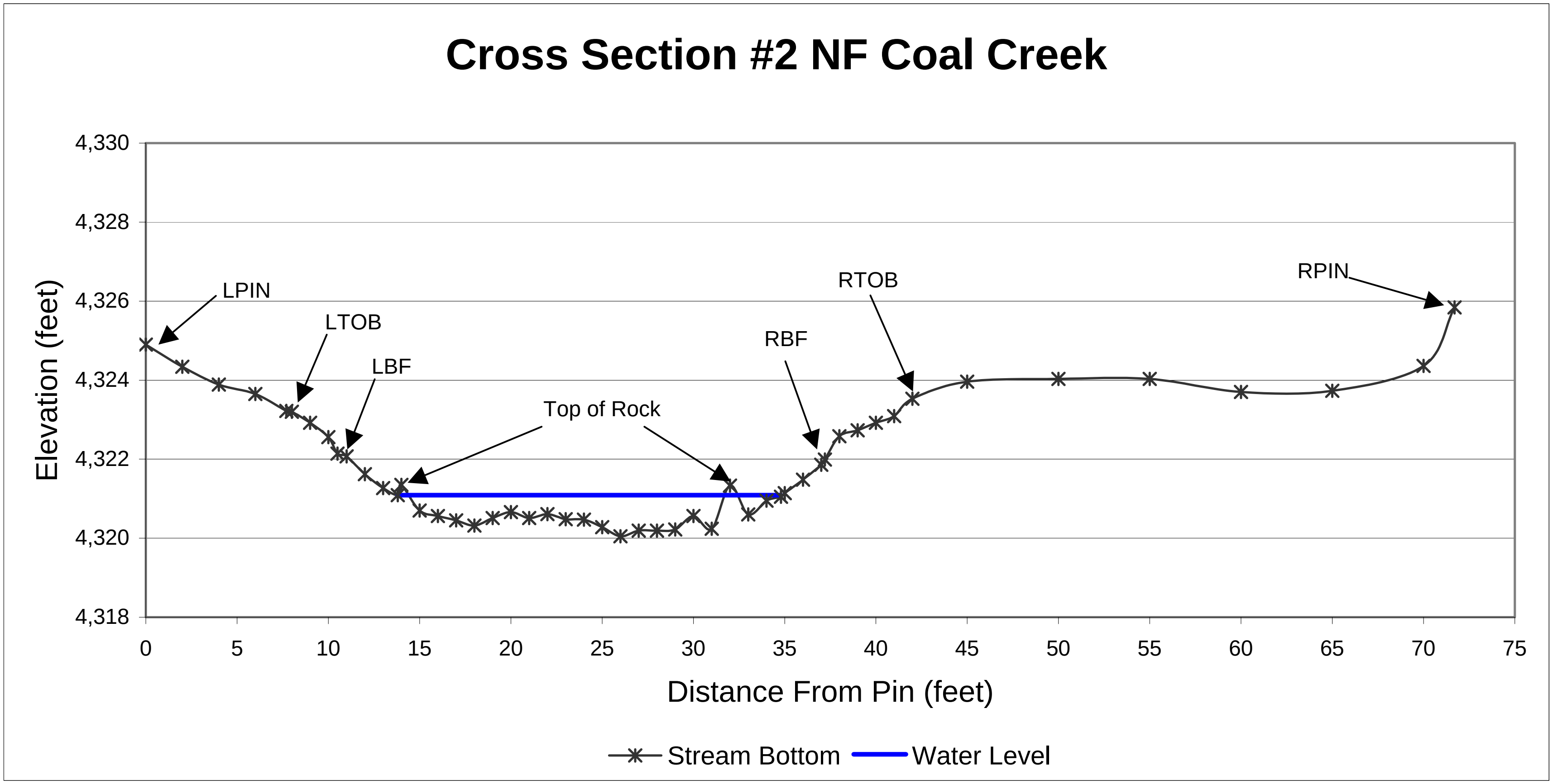
Waterbody: NF Coal #2 **STORET Station ID:** 0691863 / 53962652

Personnel: GRACE, LEWIS

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00 %	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	5		5	4.39%	4.39%
2	Sand		1 - 2	17		17	14.91%	19.30%
3	Very Fine	GRAVELS	2 - 4	3		3	2.63%	21.93%
4	Fine	GRAVELS	4 - 6	3		3	2.63%	24.56%
5	Fine	GRAVELS	6 - 8	2		2	1.75%	26.32%
6	Medium	GRAVELS	8 - 12	8		8	7.02%	33.33%
7	Medium	GRAVELS	12 - 16	6		6	5.26%	38.60%
8	Coarse	GRAVELS	16 - 22	7		7	6.14%	44.74%
9	Coarse	GRAVELS	22 - 32	13		13	11.40%	56.14%
10	Very Coarse	GRAVELS	32 - 45	9		9	7.89%	64.04%
11	Very Coarse	GRAVELS	45 - 64	9		9	7.89%	71.93%
12	Small	COBBLES	64 - 90	8		8	7.02%	78.95%
13	Small	COBBLES	90 - 128	4		4	3.51%	82.46%
14	Large	COBBLES	128 - 180	5		5	4.39%	86.84%
15	Large	COBBLES	180 - 256	10		10	8.77%	95.61%
16	Small	BOULDERS	256 - 362	2		2	1.75%	97.37%
17	Small	BOULDERS	362 - 512	3		3	2.63%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			114	0	114	100.00%	

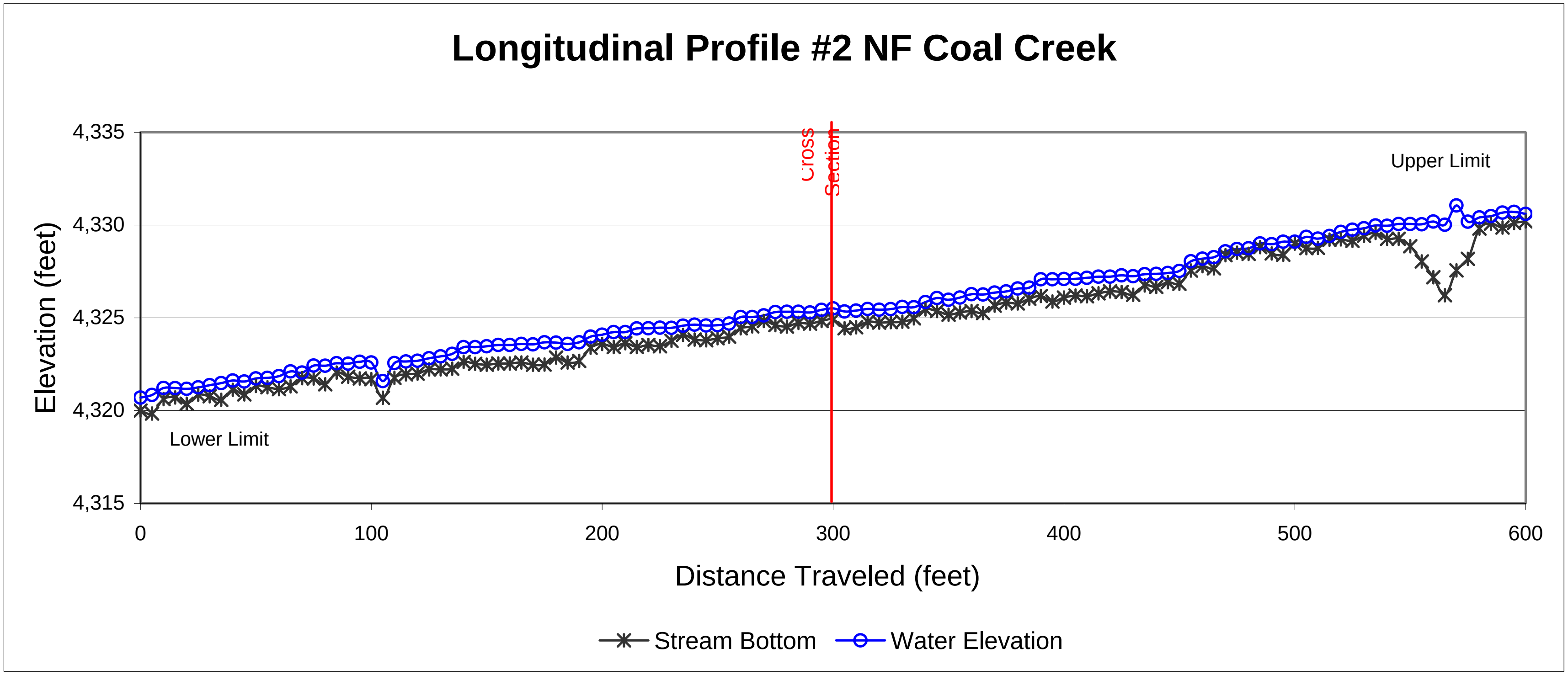
Cross Section



EXCEL filename = NFCoal#2.xls

Vertical exaggeration = 16

Longitudinal Profile



EXCEL filename = NFCoal#2.xls

Vertical exaggeration = 3.3
Data collected looking downstream.

Coal Creek

Site Visit Forms

Place Site Visit Label Here

03-0932

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-C06

Trip ID: 2003-FLTHD Date: 8/27/03

Personnel: Laidlaw/Pridmore

Waterbody Name Coal Creek County Flathead HUC 17010206

Station ID C06COALC02 Visit # ____ Location At North Fork Road

Lat 48.68819 Long 114.19916 Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☑	Macroinvertebrate Habitat Asmt. ☐	03-0932M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☐	(see comments)		
Other				

Measurements:	Time: 14:45	
Q / Flow (cfs)	—	Est. ☐
Temp: (°C)	W	A
pH:	—	
SC: (mS/cm)	—	
SC x 1000 =	—	µmho/cm
DO: (mg/L)	—	
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: 10 min 20 sec Kick Length (Ft.): 200'

Site Visit Comments: 3415' elevation.

- large cobble boulder dominated North Fork Rd downstream)
- lots of caddisflies + stoneflies present
- some bank erosion Moose Fire (01) occurred upstream)
- no embeddedness little to no sediment deposition
- 1 Flathead sculpin caught
- great riparian vegetation - mixed stand diverse vegetation willows regrowing on cobble-covered point bars

Place Site Visit Label Here 03-0933

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-C06.
Trip ID: 2003-FLTHD Date: 8/27/03
Personnel: Laidlaw/Pridmore

Waterbody Name Coal Creek County Flathead HUC 17010206
Station ID C06COALC01 Visit # ____ Location At Deadhorse
Lat 48.67480 Long 114.31652 Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0933M	(KICK) HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒	(See comments)		
Other				

Measurements:	Time: 1600	
Q / Flow (cfs)	—	Est. ☐
Temp: (°C)	W —	A —
pH:	—	
SC: (mS/cm)	—	
SC x 1000 =	—	µmho/cm
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

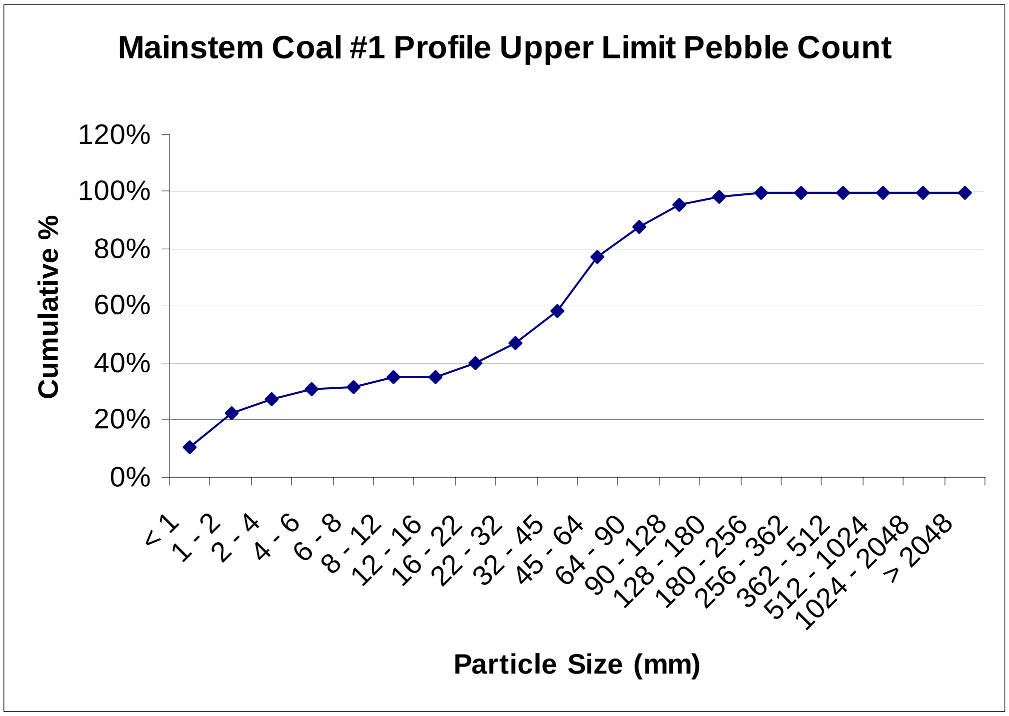
Macroinvertebrate Kick Duration: 10minutes Kick Length (Ft.): 200'

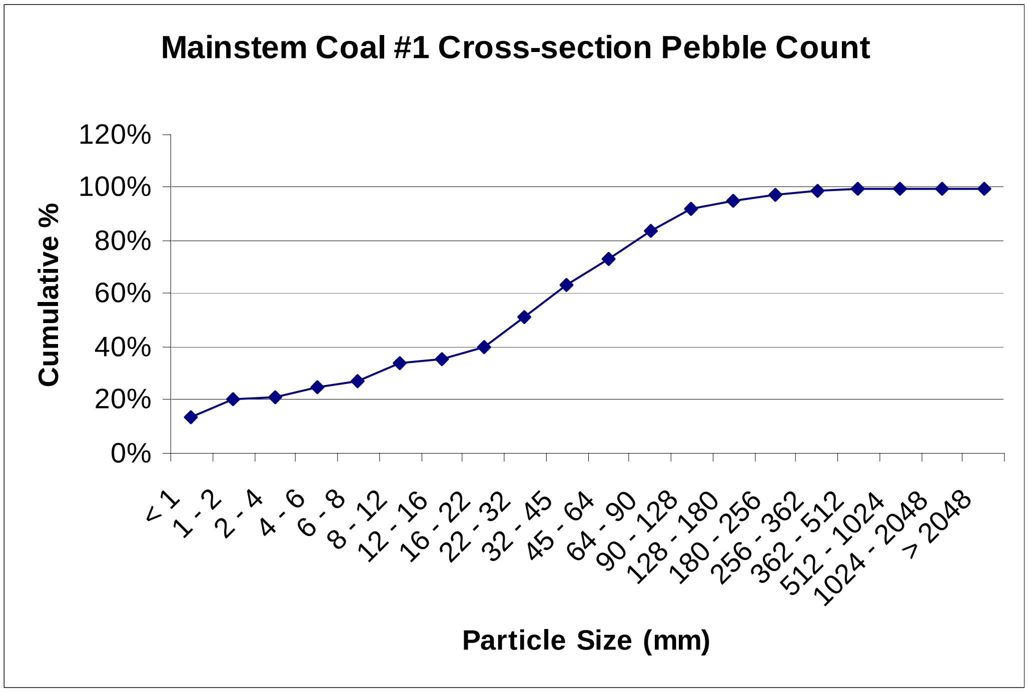
Site Visit Comments:

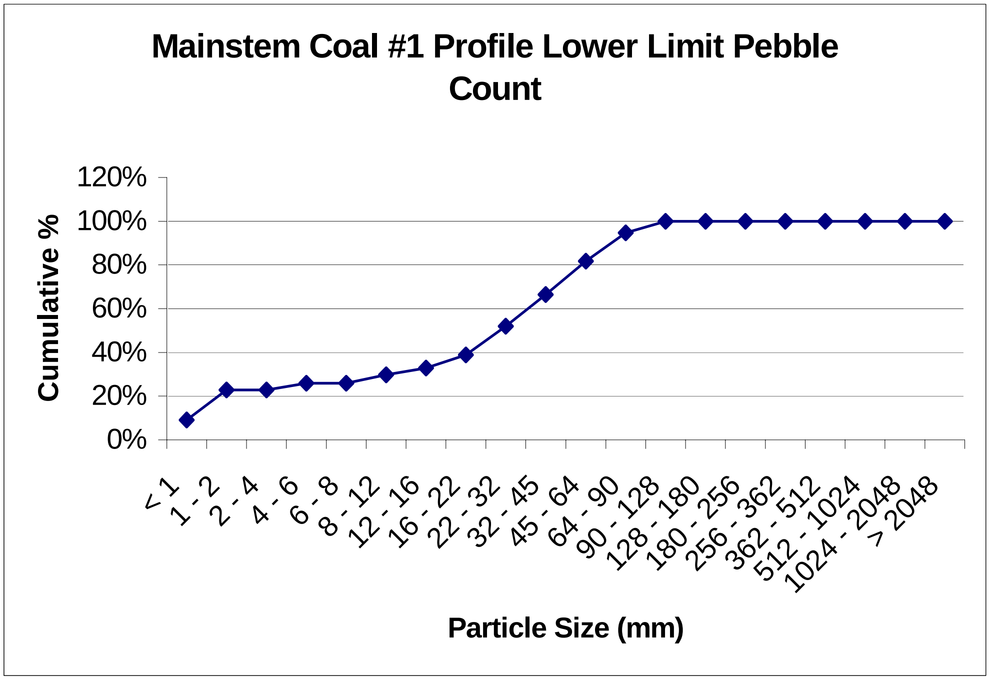
Elevation: 3885'
- woody debris in stream
- riffle w/small cobble some sand
- upstream further there was more fine sediment deposition + downed trees, some embedded rocks
- more organic material + moss present
- shallow wide stream
- extensive riparian diversity of vegetation little signs of active bank erosion

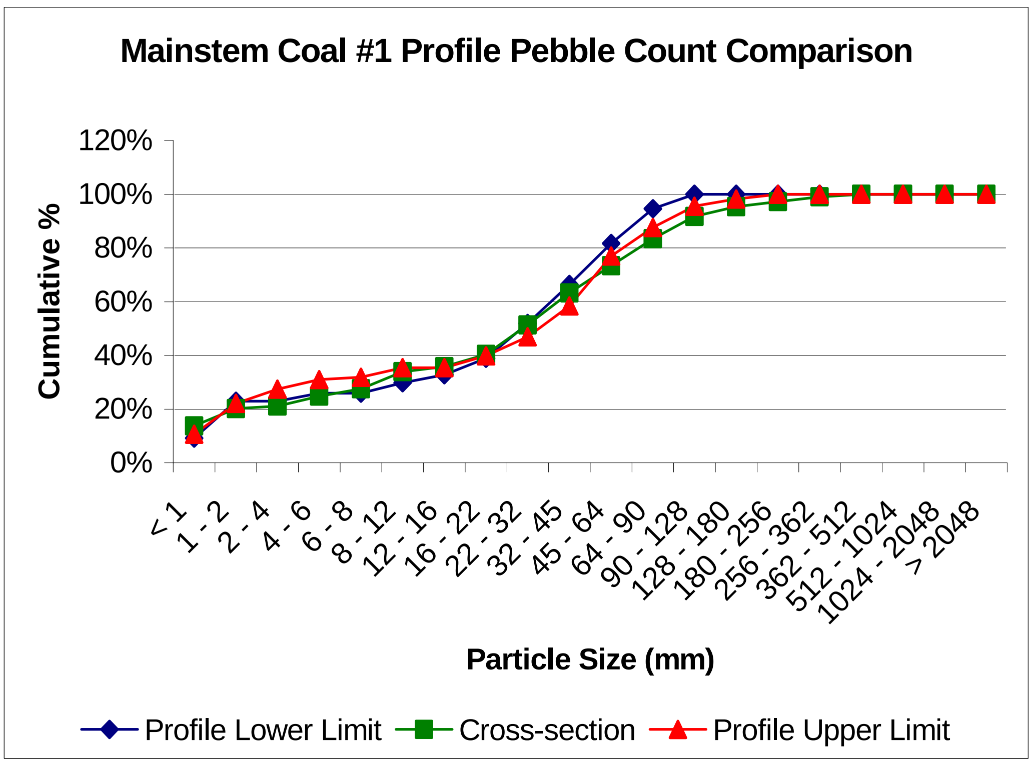
Mainstem Coal Creek #1

Pebble Counts






Mainstem Coal #1 Profile Lower Limit Pebble Count
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)


Mainstem Coal #1 Profile Pebble Count Comparison
Cumulative %
120%
100%
80%
60%
40%
20%
0%
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Profile Lower Limit
Cross-section
Profile Upper Limit

SUBSTRATE DEQ/MDM

Date: 9 Oct.2003 **Site Visit Code:** Profile#1 upper limit

Waterbody: Main-stem Coal #1 **STORET Station ID:** UTM 0690591

Personnel: LEWIS, GRACE 5394174

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Sum	% of Total	Cum. Total
				100.00 %	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	12		12	10.62%	10.62%
2	Sand		1 - 2	13		13	11.50%	22.12%
3	Very Fine	GRAVELS	2 - 4	6		6	5.31%	27.43%
4	Fine	GRAVELS	4 - 6	4		4	3.54%	30.97%
5	Fine	GRAVELS	6 - 8	1		1	0.88%	31.86%
6	Medium	GRAVELS	8 - 12	4		4	3.54%	35.40%
7	Medium	GRAVELS	12 - 16			0	0.00%	35.40%
8	Coarse	GRAVELS	16 - 22	5		5	4.42%	39.82%
9	Coarse	GRAVELS	22 - 32	8		8	7.08%	46.90%
10	Very Coarse	GRAVELS	32 - 45	13		13	11.50%	58.41%
11	Very Coarse	GRAVELS	45 - 64	21		21	18.58%	76.99%
12	Small	COBBLES	64 - 90	12		12	10.62%	87.61%
13	Small	COBBLES	90 - 128	9		9	7.96%	95.58%
14	Large	COBBLES	128 - 180	3		3	2.65%	98.23%
15	Large	COBBLES	180 - 256	2		2	1.77%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			113	0	113	100.00%	

Characteristic Group: PEBL-CNT

SUBSTRATE DEQ/MDM

Date: 9 Oct.2003 **Site Visit Code:** Profile #1 CROSS-SECTION

Waterbody: Mainstem Coal#1 **STORET Station ID:** UTM 0696987/5394432

Personnel: LEWIS, GRACE

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	15		15	13.76%	13.76%
2	Sand		1 - 2	7		7	6.42%	20.18%
3	Very Fine	GRAVELS	2 - 4	1		1	0.92%	21.10%
4	Fine		4 - 6	4		4	3.67%	24.77%
5	Fine		6 - 8	3		3	2.75%	27.52%
6	Medium		8 - 12	7		7	6.42%	33.94%
7	Medium		12 - 16	2		2	1.83%	35.78%
8	Coarse		16 - 22	5		5	4.59%	40.37%
9	Coarse		22 - 32	12		12	11.01%	51.38%
10	Very Coarse		32 - 45	13		13	11.93%	63.30%
11	Very Coarse		45 - 64	11		11	10.09%	73.39%
12	Small	COBBLES	64 - 90	11		11	10.09%	83.49%
13	Small		90 - 128	9		9	8.26%	91.74%
14	Large		128 - 180	4		4	3.67%	95.41%
15	Large		180 - 256	2		2	1.83%	97.25%
16	Small	BOULDERS	256 - 362	2		2	1.83%	99.08%
17	Small		362 - 512	1		1	0.92%	100.00%
18	Medium		512 - 1024			0	0.00%	100.00%
19	Large		1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			109	0	109	100.00%	

SUBSTRATE DEQ/MDM								
Date: 9 Oct. 2003				**Site Visit Code:** Profile #1 lower limit				
Waterbody: Mainstem Coal #1				**STORET Station ID:** UTM 0697102/5394524				
Personnel: LEWIS, GRACE								
PEBBLE COUNT								
Row ID	**Particle Category**		**Size (mm)**	**Riffle Count**	**(Other) Count**	***Characteristic Group: PEBL-CNT***		
				100.00%	**0.00%**	**Sum**	**% of Total**	**Cum. Total**
1	**Silt / Clay**		**< 1**	**12**		**12**	9.16%	9.16%
2	**Sand**		**1 - 2**	**18**		**18**	13.74%	22.90%
3	**Very Fine**	**GRAVELS**	**2 - 4**			**0**	0.00%	22.90%
4	**Fine**	**GRAVELS**	**4 - 6**	**4**		**4**	3.05%	25.95%
5	**Fine**	**GRAVELS**	**6 - 8**			**0**	0.00%	25.95%
6	**Medium**	**GRAVELS**	**8 - 12**	**5**		**5**	3.82%	29.77%
7	**Medium**	**GRAVELS**	**12 - 16**	**4**		**4**	3.05%	32.82%
8	**Coarse**	**GRAVELS**	**16 - 22**	**8**		**8**	6.11%	38.93%
9	**Coarse**	**GRAVELS**	**22 - 32**	**17**		**17**	12.98%	51.91%
10	**Very Coarse**	**GRAVELS**	**32 - 45**	**19**		**19**	14.50%	66.41%
11	**Very Coarse**	**GRAVELS**	**45 - 64**	**20**		**20**	15.27%	81.68%
12	**Small**	**COBBLES**	**64 - 90**	**17**		**17**	12.98%	94.66%
13	**Small**	**COBBLES**	**90 - 128**	**7**		**7**	5.34%	100.00%
14	**Large**	**COBBLES**	**128 - 180**			**0**	0.00%	100.00%
15	**Large**	**COBBLES**	**180 - 256**			**0**	0.00%	100.00%
16	**Small**	**BOULDERS**	**256 - 362**			**0**	0.00%	100.00%
17	**Small**	**BOULDERS**	**362 - 512**			**0**	0.00%	100.00%
18	**Medium**	**BOULDERS**	**512 - 1024**			**0**	0.00%	100.00%
19	**Large**	**BOULDERS**	**1024 - 2048**			**0**	0.00%	100.00%
20	**Bedrock**		**> 2048**			**0**	0.00%	100.00%
21	**Total # Samples**			**131**	**0**	**131**	**100.00%**	

Coal Creek Main-stem Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Main-stem 0.294-0.394 15 July 1976	Main-stem 8.492-8.592 30 June 1976	Main-stem 0.294-0.394 21 June 1979	Main-stem 8.49-8.59 27 June 1979	Main-stem 8.44-8.68 8 Oct. 1985	Main-stem 8.68-9.47 8 Oct. 1985
Landform slope	6	2	6	4	2	2
Mass wasting	7	3	3	3	6	6
Debris jam potential	5	6	2	2	2	7
Vegetative bank protection	5	3	9	3	7	6
LOWER BANKS						
Channel capacity	1	2	1	1	2	3
Bank rock content	6	6	4	6	5	6
Obstructions/flow deflectors/sediment traps	4	2	2	4	3	6
Cutting	8	4	12	4	8	12
Deposition	6	4	4	0	6	12
BOTTOM						
Rock angularity	2	2	2	2	2	3
Brightness	2	2	1	2	3	3
Consolid or particle packing	4	3	2	2	5	5
Bottom size distribution / percent stable materials	8	8	4	4	9	12
Scouring and deposition	12	8	12	12	12	16
Clinging aquatic vegetation	3	3	2	2	3	3
TOTALS	**79**	**58**	**66**	**51**	**75**	**102**

Coal Creek Main-stem Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Main-stem 8.53-8.63 26 Sept.94	Main-stem 7.92-8.15 14 Aug.97	Profile #1 UL 9 Oct.03	Profile #1 CS 9 Oct. 03	Profile #1 LL 9 Oct. 03	Cross-Section #2 15 Oct.03
Landform slope	4	6	6	4	2	2
Mass wasting	6	3	6	3	3	3
Debris jam potential	2	8	6	8	8	6
Vegetat bank protection	3	6	6	6	3	6
LOWER BANKS						
Channel capacity	3	4	4	1	1	2
Bank rock content	6	6	6	4	8	2
Obstructions/flow deflectors/sediment traps	2	6	6	6	8	2
Cutting	8	12	12	8	8	12
Deposition	4	12	16	12	16	8
BOTTOM						
Rock angularity	2	3	3	3	4	2
Brightness	4	4	4	3	3	2
Consolid or part packing	2	6	8	6	8	4
Bottom size distribution / percent stable materials	8	16	12	8	16	4
Scouring and deposition	12	18	24	6	18	12
Clinging aquatic vegetat	2	4	2	3	3	3
TOTALS	**68**	**114**	**121**	**81**	**109**	**56**

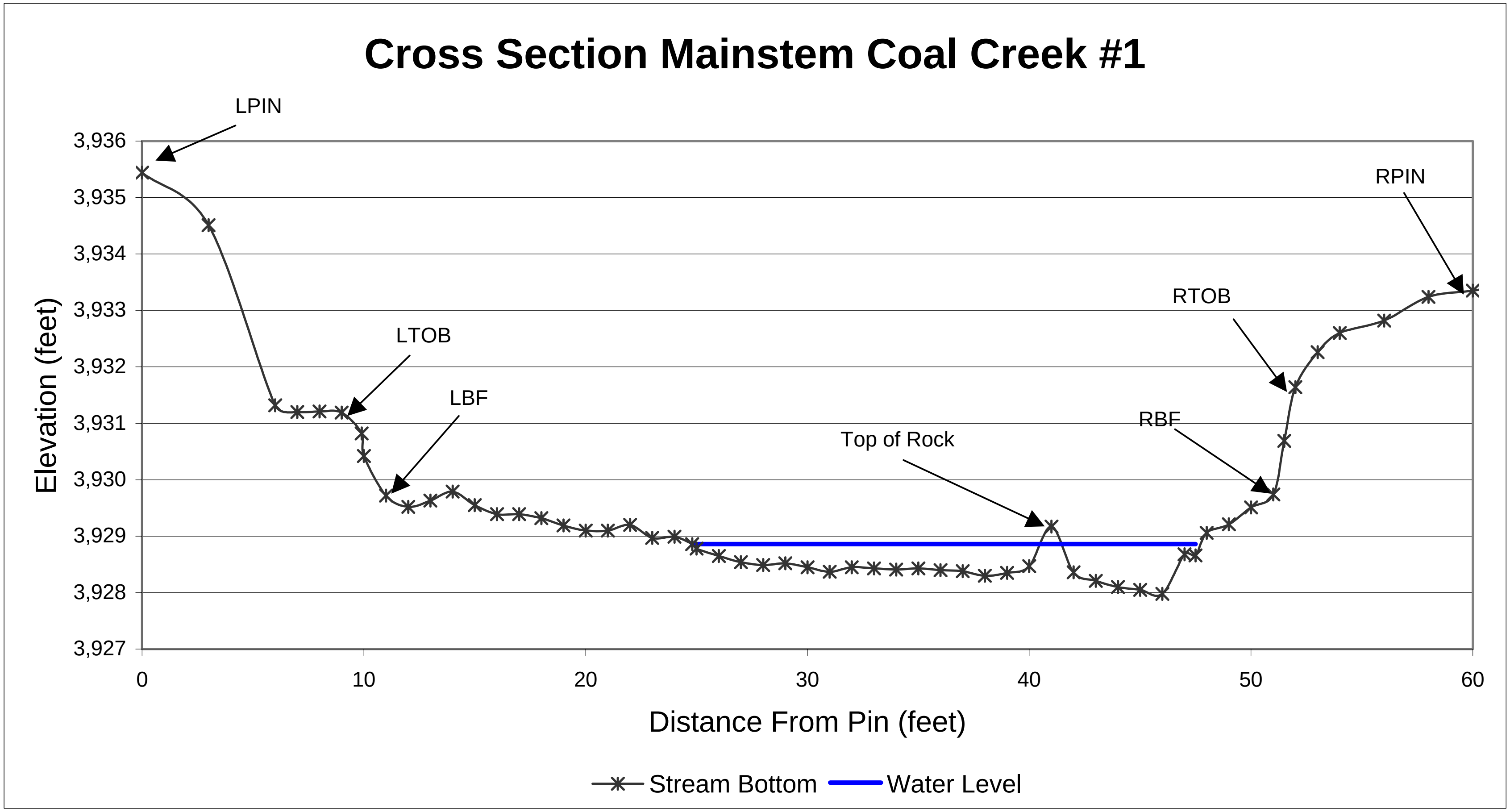
Coal Creek Main-stem Tributaries Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Deadhorse Cr. 1.7-1.8 12 July 1976	Deadhorse Cr. 3.69-3.69 12 July 1976	Deadhorse Cr. 5.19-5.29 11 July 1976	Deadhorse Cr. 1.7-1.8 29 June 1979	Deadhorse Cr. 3.69-3.69 28 June 1979	Deadhorse Cr. 5.19-5.29 28 June 1979
Landform slope	2	2	5	4	4	4
Mass wasting	3	3	8	3	3	3
Debris jam potential	6	8	8	6	2	6
Vegetative bank protection	6	4	5	3	6	3
LOWER BANKS						
Channel capacity	2	2	2	2	1	1
Bank rock content	6	6	5	8	6	4
Obstructions/flow deflectors/sediment traps	4	4	8	4	2	4
Cutting	6	8	8	8	8	8
Deposition	8	6	5	8	4	4
BOTTOM						
Rock angularity	2	2	2	2	2	2
Brightness	2	2	2	2	1	1
Consolid or particle packing	4	4	4	4	2	4
Bottom size distribution / percent stable materials	8	4	8	8	4	4
Scouring and deposition	10	10	8	12	12	6
Clinging aquatic vegetation	3	3	3	2	2	2
TOTALS	**72**	**68**	**81**	**76**	**59**	**56**

Coal Creek Main-stem Tributaries Historic Pfankuch Rating Comparison

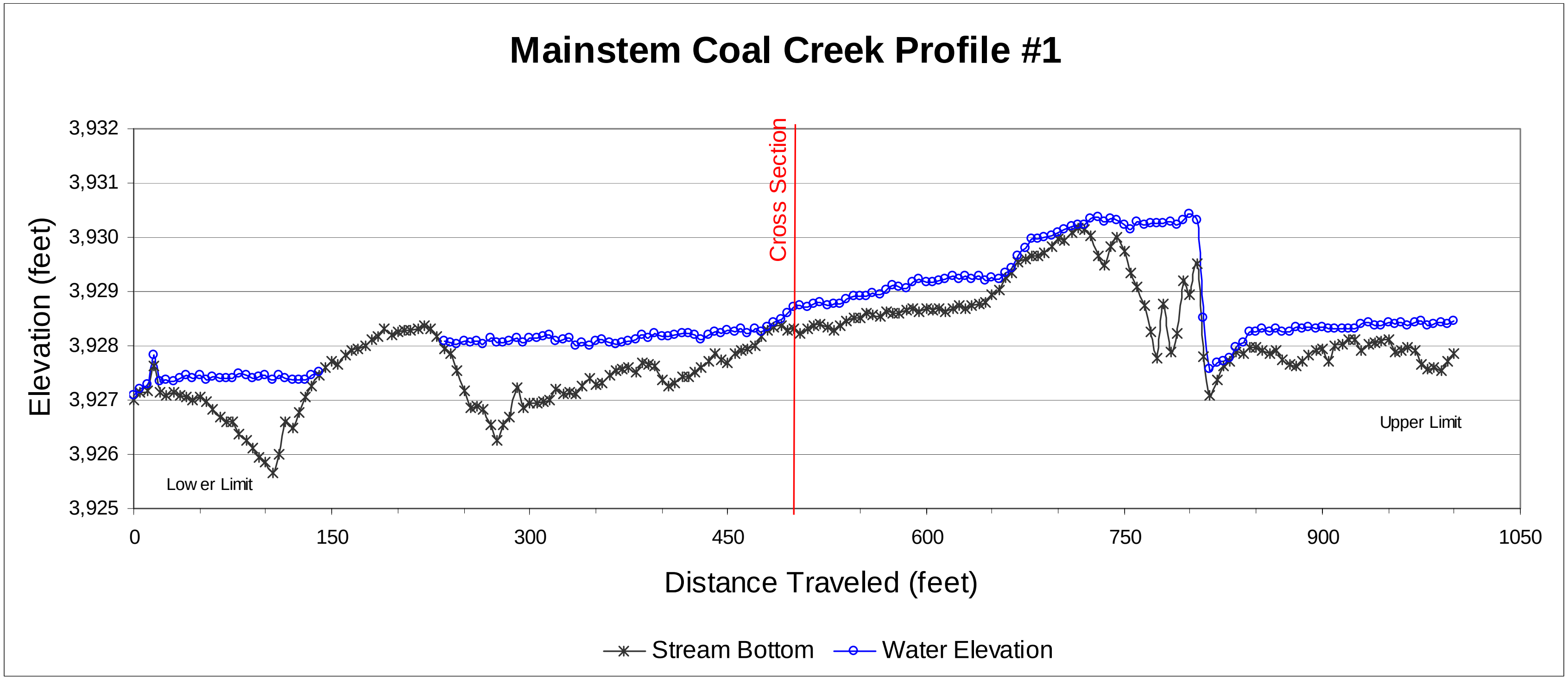
UPPER BANKS	**Stream segment Date**	**Stream segment Date**
	Cyclone Cr. 5.63-5.73 15 July 1976	Cyclone Cr 6.92-7.02 14 July 1976
Landform slope	2	2
Mass wasting	3	8
Debris jam potential	8	5
Vegetative bank protection	4	4
LOWER BANKS		
Channel capacity	2	1
Bank rock content	6	4
Obstructions/flow deflectors/sediment traps	7	2
Cutting	8	12
Deposition	7	7
BOTTOM		
Rock angularity	2	2
Brightness	2	2
Consolid or particle packing	4	4
Bottom size distribution / percent stable materials	8	8
Scouring and deposition	12	12
Clinging aquatic vegetation	2	2
TOTALS	**77**	**75**

Cross Section



Data recorded looking downstream.
EXCEL filename: Upper Main Coal Creek.xls
Vertical exaggeration = 15

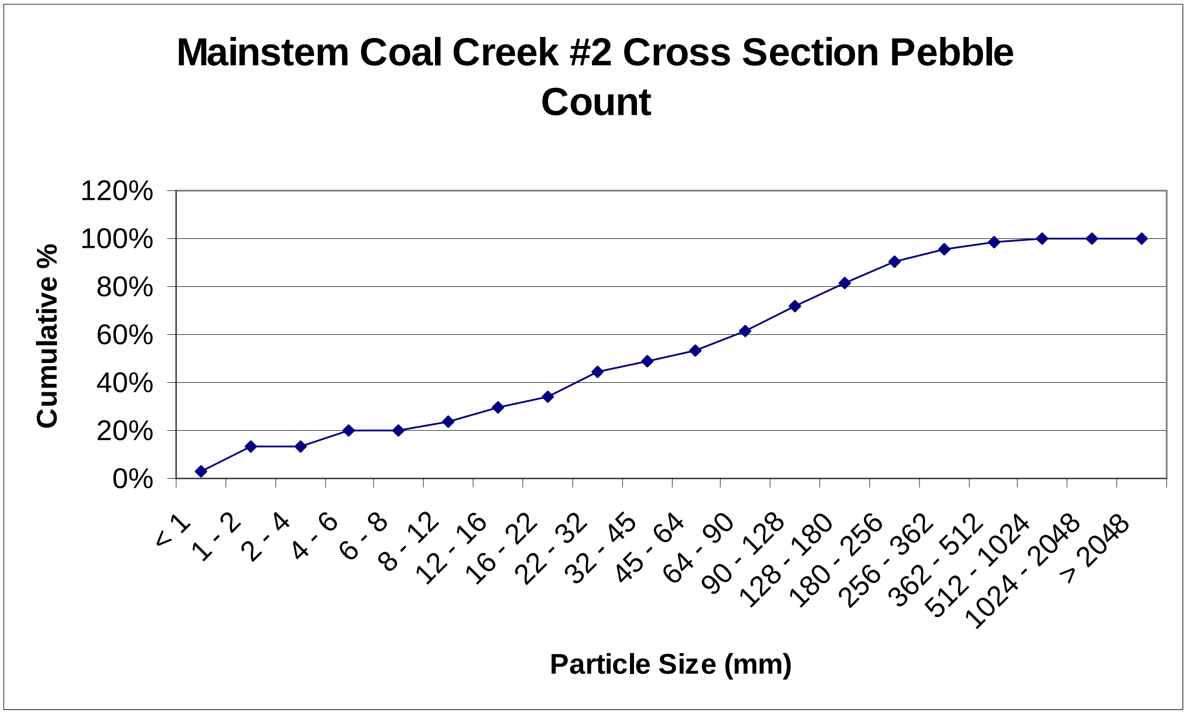
Longitudinal Profile



EXCEL filename: Upper Main Coal Creek.xls
Vertical exaggeration = 0.9

Mainstem Coal Creek #2

Pebble Counts



SUBSTRATE DEQ/MDM

Date: 10/15/2003
Waterbody: Mainstem Coal Creek #2
Personnel: J. Grace, C Lewis
Site Visit Code: Cross Section
STORET Station ID:

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	4		4	3.28%	3.28%
2	Sand		1 - 2	12		12	9.84%	13.11%
3	Very Fine	GRAVELS	2 - 4	0		0	0.00%	13.11%
4	Fine	GRAVELS	4 - 6	8		8	6.56%	19.67%
5	Fine	GRAVELS	6 - 8	0		0	0.00%	19.67%
6	Medium	GRAVELS	8 - 12	5		5	4.10%	23.77%
7	Medium	GRAVELS	12 - 16	7		7	5.74%	29.51%
8	Coarse	GRAVELS	16 - 22	6		6	4.92%	34.43%
9	Coarse	GRAVELS	22 - 32	12		12	9.84%	44.26%
10	Very Coarse	GRAVELS	32 - 45	6		6	4.92%	49.18%
11	Very Coarse	GRAVELS	45 - 64	5		5	4.10%	53.28%
12	Small	COBBLES	64 - 90	10		10	8.20%	61.48%
13	Small	COBBLES	90 - 128	13		13	10.66%	72.13%
14	Large	COBBLES	128 - 180	11		11	9.02%	81.15%
15	Large	COBBLES	180 - 256	11		11	9.02%	90.16%
16	Small	BOULDERS	256 - 362	7		7	5.74%	95.90%
17	Small	BOULDERS	362 - 512	3		3	2.46%	98.36%
18	Medium	BOULDERS	512 - 1024	2		2	1.64%	100.00%
19	Large	BOULDERS	1024 - 2048	0		0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048	0		0	0.00%	100.00%
21	Total # Samples			122	0	122	100.00%	

Granite Creek






Site Visit Forms

Place Site Visit Label Here 03-0937

C07GRNTC02 TV

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-C07
Trip ID: 2003-FLTHD Date: 9-10-03
Personnel: Donna Ridmore, Clifford Lewis

Waterbody Name * Granite Creek County Flathead HUC 17010207-0203 6th CODE NRCS
Station ID * C07GRNTC02 Visit # ____ Location 240 ft downstream from Tumbler Creek Confluence.
Lat 48.22313° Long 113.33156° Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☒ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0937M *	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 15:19	
Q / Flow (cfs)	—	Est. ☐
Temp: (°C)	W —	A —
pH:	—	
SC: (mS/cm)	—	
SC x 1000 =	—	µmho/cm
DO: (mg/L)	—	
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: 15 min 27 sec Kick Length (Ft.): 70 ft

Site Visit Comments:

Elevation: 4977 ft
Stream Dry above Tumbler Creek and Below Sign Creek Confluences
Approx. 1 mile of Stream flow
• Riffle with Small Cobble. Some Gravel
• Signs of Bank erosion - Reminants of 1964 flood
• Unconfined Channel, Evidence of Beaver activity redirecting flow
• Dense Tree stands. Extensive riparian vegitation

Flathead National Forest Documents

Substrate DEQ/MDM

Stream Name Granite Creek Station ID GCS-GUL-GLL Date 7-16-03

Site Visit Code Personnel R. Lindahl R. Wikel

Particle Category		Size Category (mm)	Pebble Count: Dot and Dash Count ⁘ = 3, ☒ = 10 (UL)	(X-SEC)	(LL)	Sum	% of Total	Cum. Total
Silt/Clay		< 1						
Sand		1-2						
Very Fine	Gravels	2-4						
Fine	Gravels	4-6						
Fine	Gravels	6-8						
Medium	Gravels	8-12						
Medium	Gravels	12-16						
Coarse	Gravels	16-22						
Coarse	Gravels	22-32						
Very Coarse	Gravels	32-45						
Very Coarse	Gravels	45-64						
Small	Cobbles	64-90						
Small	Cobbles	90-128						
Large	Cobbles	128-180						
Large	Cobbles	180-256						
Small	Boulders	256-362						
Small	Boulders	362-512						
Medium	Boulders	512-1024						
Large	Boulders	1024-2048						
Bedrock	Boulders	>2048						
Total # of Samples								

FOR INFORMATION

Granite Creek (Lower Limits)
7-16
(LPS-10: Lower Limit)

K. Lindahl
K. W

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

FOR INFORMATION

Add the values in each column for a total reach score here. (E.____ + G.____ +F.____ +P.____ = ____)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

Granite Creek (Upper Limit)
7-10
(6PS-10-GUL)

K. Lindani
K. W.

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
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Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occassional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
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Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
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Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

Add the values in each column for a total reach score here. (E.____ + G.____ +F.____ +P.____ = ____)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR INFORMATION

GRA[illegible]E Creek (Cross-Section)
7-1[illegible] 3
(GPS-ID: GCS)

FLATHE[illegible]ATIONAL FOREST
STREAM REACH INVENTOR[illegible]ND CHANNEL STABILITY EVALUATION

JL	LL	ITEM RATED	EXCELLENT		GOOD		FAIR		POOR	
			STABILITY INDICATORS BY CLASSES							
		UPPER BANKS								
E	E	Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
F	F	Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
F	F	Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
G	G	Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
		LOWER BANKS								
P	P	Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occassional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
F	F	Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
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		BOTTOM								
G	G	Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
P	P	Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
G	G	Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
P	P	Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
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P	P	Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		COLUMN TOTALS								

FOR INFORMATION

Add the values in each column for a total reach score here. (E.____ + G.____ +F.____ +P.____ = ____)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

Miscellaneous Documents

Public Comment #58 Exhibit #17

RECEIVED

SEP 0 6 2000

DEQ / PPA
Monitoring & Data Management Bureau

Granite Creek (1402)

Granite Creek is a 4th order tributary to the Middle Fork. The lower half of the creek is in the wilderness. Bull trout spawn just below the wilderness boundary to below Dodge Creek. Bull trout juveniles are occasionally collected in Challenge Creek but in limited numbers. Most rearing occurs in Granite Creek.

Subpopulation Size- Redd counts are conducted annually and have ranged from a low of 4 in 1996 to a high of 47 in 1984 (see redd count Table 1 above).

Juvenile bull trout populations in Challenge Creek.

Year	1981	1982	1983	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Pop. est.	7	1	2	1	8	6	3	2	2	21	1	9	57	9	25

The increase in juveniles in 1995 and 1997 is hard to explain. It's possible that for some reason fish moved up from Granite Creek to rear.

This subpopulation is functioning at unacceptable risk since its dependent on Flathead Lake bull trout. FUR

Growth and Survival- This subpopulation is most likely in decline and will not improve until measures are taken to alleviate the changes in Flathead Lake. This subpopulation is functioning at unacceptable risk. FUR .

Life History Diversity and Isolation- The migratory form is present albeit in depressed numbers. No resident forms are known to exist. Recolonization is unlikely if the migratory form is lost. This subpopulation is functioning at risk. FAR

Persistence and genetic Integrity- No introgression of bull trout has been documented. The potential for hybridization is non-existent given that brook trout are not present in the watershed. Evidence suggests that there is substantial genetic divergence among bull trout populations from different sub-basins in the Flathead (Kanda et al. 1994). The amount of genetic divergence among populations within sub-basins is smaller which suggests that there is some gene flow among subpopulations. Competition/predation is occurring with lake trout in Flathead Lake and all 12 members on a panel of fishery experts responded that there is a greater than 70% probability that this interaction is preventing a recovery goal maintaining 1980's bull trout populations for at least 15 years (McIntyre 1998). Therefore, the probability of this population persisting is low and is functioning at risk. FAR

Temperature- There were 145 incidental temperature measurements associated with water quality monitoring procedures between 1980 to 1995 on Dodge Creek. The maximum water temperature recorded was 13.0 C. There were 149 incidental temperature measurements associated with water quality monitoring procedures between 1980 to 1995 on Challenge Creek. The maximum water temperature recorded was 12.8 C. FA

Sediment- The Flathead National Forest adopted Flathead Basin Commission recommendations for sediment in 1992 through Implementation Note #10. In short, streams that have greater than 35% fines

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DHz Comment #58/

(<6.4mm) are considered threatened while streams with greater than 40% fines are considered impaired. McNeil core samples have been taken in Granite Creek since 1982.

Year	1982	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Challenge	----	41.2	33.4	41.8	45.3	33	38.2	41.9	36.8	34.6	37.9
Granite	44.6	----	41.4	45.4	45.1	33	37.9	41.6	36	33.5	----

Chemical Contamination/Nutrients- There are no concerns with chemical contamination. Both Granite and Challenge creeks are on the State's 303(d) list of impaired water bodies with aquatic life support (cold water fishery - trout) the probable impaired use. And the probable cause being siltation , or habitat alterations, with the probable source being silviculture practices, and natural sources in Granite Creek. FAR

Habitat Access- There are no man made barriers in this watershed. FA

Embeddedness- The Flathead National Forest does not measure embeddedness. FA

Large Woody Debris- The 1981 survey indicated that debris was moderate. Most riparian zones are intact. FA

Pool Frequency- The 1981 survey determined that pool habitat ranged from 4 to 15%. FAR

Large Pools- The 1981 survey used a pool classification system to indicate the value of the pool as fish habitat based upon size, depth and cover. Class I or II pools were zero to 67% in the 1981 survey. Overall, pool quality was poor. FAR

Off Channel Habitats- Off channel habitats are available throughout Granite Creek. FA

Refugia- There is a lot of available habitat in this system that is connected to the Middle Fork and there are no exotic species in the drainage. FA

Wetted Width/Max. Depth Ratio- The average width/depth ratio is not available. Best professional judgement suggests FAR due to the lack of pools and bedload in Dodge Creek.

Streambank Stability- The R-1 Stream Channel Stability Ratings for Granite Creek completed between 1980 were 95 to 102. The R-1 Stream Channel Stability Ratings for Challenge Creek completed between 1980 and 1987 were 62 to 102. The R-1 Stream Channel Stability Ratings for Dodge Creek completed between 1980 to 1987 were 74 to 100. All of these ratings between a good condition (39-76) and a fair condition (77-114). There are several areas in Challenge, Dodge, and Granite Creek where streambanks are unstable and slumping into the creeks. FAR

Floodplain Connectivity- The stream has access to its floodplain. FAR

Peak Flow- The water yield increase was modeled for the basin in 1991 using the H2OY model. That model predicted a 7.5% annual water yield increase due to the roading and harvest activities. There are visual indicators of bedload movement in several reaches of this stream system. FAR

Drainage Network- There are areas of roads and skid trails that intercept near surface groundwater during the spring snow melt period. These areas effectively extend the channel network. FAR

Road Density and Location- There are 20 miles of road in Granite Creek with a density of 0.7. The roads are not in the stream bottom. FA

Disturbance History- High intensity harvest older than 20 years has occurred on 1,124 acres and 181 acres less than 20 years. Low intensity harvest older than 20 years has occurred on 156 acres and 1,803 acres less than 20 years. Upper Granite Creek and Challenge Creek has had a fair amount of harvest on what is considered the most sensitive soils on the Forest. FAR

Riparian Conservation Areas- The riparian area for the most part is intáct although there is a lot of blow-down along the stream. FA

Disturbance Regime- There are no fires are avalanches. FA

Integration of Species and Habitat Conditions- Granite Creek and its tributaries provide good habitat that is connected but populations are depressed due to changes in Flathead Lake. FAR

Morrison Creek (1403)

Morrison Creek is a 4th order tributary to the Middle Fork. Bull trout have access throughout the stream. A partial log jam barrier was worked on in 1995 to allow complete passage. Most spawning occurs about a mile below Lodgepole Creek to just below the trailhead.

Subpopulation Size- Redd counts are conducted annually and are shown in the Table 1. Juvenile population estimates have been taken since 1980.

Year	1980	1982	1983	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Morrison	91	93	62	93	114	138	126	130	28	87	24	91	16	93	24	34

This subpopulation is functioning at unacceptable risk since its dependent on Flathead Lake bull trout. FUR

Growth and Survival- This subpopulation is most likely in decline and will not improve until measures are taken to alleviate the changes in Flathead Lake. This subpopulation is functioning at unacceptable risk. FUR

Life History Diversity and Isolation- The migratory form is present albeit in depressed numbers. No resident forms are known to exist. Recolonization is unlikely if the migratory form is lost. This subpopulation is functioning at risk. FAR

Persistence and genetic Integrity- No introgression of bull trout has been documented. The potential for hybridization is non-existent given that brook trout are not present in the watershed. Evidence suggests that there is substantial genetic divergence among bull trout populations from different sub-basins in the Flathead (Kanda et al. 1994). The amount of genetic divergence among populations within sub-basins is smaller which suggests that there is some gene flow among subpopulations. Competition/predation is ccurring with lake trout in Flathead Lake and all 12 members on a panel of fishery experts responded eat there is a greater than 70% probability that this interaction is preventing a recovery goal maintaining 1980's bull trout populations for at least 15 years (McIntyre 1998). Therefore, the probability of this population persisting is low and is functioning at risk. FAR

TMDL Full or Partial Report Page 1 of 1

enviroNET Watershed Information
Montana Department of Environmental Quality

Report 1 of 1
Select Form

Waterbody: MT76I002_010 - Granite Creek(River) - 8.2 Miles Map Waterbody
Waterbody on year 2000 303d list?: Yes Assessment Record Sheet Help

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Description: GRANITE CREEK, Confluence of Dodge Cr & Challenge Cr to mouth (Middle Fk Flathead)

EcoRegion(s):	Northern Rockies	**Hydro Unit:**	17010207
County(s):	FLATHEAD	**Basin:**	Columbia
		Watershed:	Flathead

Beneficial Uses:	**Fully**	**Threatened**	**Use Support** **Partial**	**Not Supporting**	**Not Assessed**
Agriculture					X
Aquatic Life Support			X		
Cold Water Fishery - Trout			X		
Drinking Water Supply					X
Industrial					X
Primary Contact (Recr)					X

Probable Causes:
Bank erosion
Fish habitat degradation
Other habitat alterations
Siltation

Probable Sources:
Silviculture
Construction
  Highway/Road/Bridge Construction
Habitat Modification-other than Hydromodification
  Bank or Shoreline Modification/Destabilization

Assessment Methods and Information Sources:
Ecological/habitat surveys
Fish surveys
Monitoring data more than 5 years old
Visual observation, may not quantify some parameters; single season; by prof.

Report 1 of 1

I. SUFFICIENT CREDIBLE DATA-SOURCE CHECKLIST

WATERBODY LOCATION	Tributary to Middle Fk. Flathead River
WATERBODY NAME	Granite Creek
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207
WATER CLASSIFICATION	B-1
SEGMENT LENGTH (MILES)	8.2
ASSESSMENT BY	Jed Chesnut, Jessie Tippie
ASSESSMENT DATE (MDY)	10/15/1999, 09/28/00

DATA SOURCE	CHK'D ?	DOCUMENT TITLES	DOCUMENT LOCATION	*ASSIGNED NUMBER*	BIOLOGICAL DATA	HABITAT DATA	CHEMISTRY/ PHYSICAL DATA
DEQ	Y	Gangemi, J. 1989. DEQ field stream assessment.	DEQ file	13		13RPF	
FWP	Y	Liknes, G. 1984. The Present Status and Distribution of the Westslope Cutthroat Trout (Salmo Clarki Lewisi) East and West of the Continental Divide in Montana.	DEQ file	1	1F		
		F-7-R-35 Ia. Domrose, R. 1986. Inventory of Waters of the Project Area. Northwest Montana Fishery Study.	DEQ file	2	2F		
		F-7-R-36 Ia. Domrose, R. 1987. Inventory of Waters of the Project Area. Northwest Montana Fishery Study.	DEQ file	3	3F		
		F-46-R-2 Va. Hanzel, D., et al. 1989. Survey and Inventory of Coldwater and Warmwater Ecosystems. Flathead Lake-River System Study. Statewide Fisheries Investigations.	DEQ file	4	4F		
		Deleray, M., et al. 1999. Flathead Lake and River System. Fisheries Status Report.	DEQ file	5	5F		
		Weaver, T., et al. 1988. Coal Creek Fisheries Monitoring Study No. VI and Forest-Wide Fisheries Monitoring-1987.	DEQ file	7	7F		
		Weaver, T. 1989. Coal Creek Fisheries Monitoring Study No. VII and Forest-Wide Fisheries Monitoring-1988.	DEQ file	8	8F		
NRCS	N						
USFS	Y	Tralles, S. 1991. Application of the Montana Nonpoint Source Stream Reach Assessment in the Flathead Basin.	DEQ file	10		10RPF	
		Weaver, T., et al. 1991. Fisheries Habitat and Fish Populations.	DEQ file	11	11F		
		USFS. 1998. Watershed Biological Assessment for Bull Trout. July 1998.	DEQ file	14	14F	14RPF	
USGS	Y						
MRIS	Y	MRIS Reports	DEQ file	12	12F	12RPF	
CDs	N						
USFWS	N						
U OF M	Y						
MSU	Y						
MONTANA TECH.	Y						
MRWA	N						
BOR	Y						
DNRC	Y						
BLM	Y						
MDOT	N						
P CRK	N						
MT NAT	N						
CHAMP	N						
CORPS	Y						
MPC	N						
MTDAK UT	N						
TRIBES	N						

MBMG	N						
EPA	Y	Fraley, F., et al. 1981. Flathead River Fishery Study, April 1981.	DEQ file	6	6F		6P
		Shepard, B., et al. 1982. Flathead River Fisheries Study-1982.	DEQ file	9	9F		
WWP/AVISTA	N						
WDEQ	Y						
YNP	Y						
NPS	Y						
VOLUNTEER	N						
OTHER	Y						

SEGMENT DESCRIPTION	Granite Creek, confluence of Dodge Creek and Challenge Creek to mouth (Confluence with Middle Fork Flathead River).
DATA NOT EXAMINED	
COMMENTS	No chemistry data, but detailed habitat and fishery data available. Data is sufficient to assess.
CODES	**Biological data:** F = fish; M = macroinvertebrates; A = algae; CL = chlorophyll; W = wildlife; E = fecal coliforms; B = other bacteriological data **Water Chemistry & Toxicological data:** N = major nutrients; ME = metals; C = common ions, pH, conductivity, miscellaneous.; T = toxicity tests SD=benthic sediment data; O = organics; BA = bioaccumulation. **Physical data:** P = quantitative physical data; RG = Rosgen type; RI = radiological data **Habitat Data:** RPF =riparian and/or instream surveys, and physical features; K=photo points; LU = land use.
NOTE	Biological, Water Quality & Toxicological, and Physical Habitat data were assigned level of information scores from 1 to 4. The level of information is scored in accordance with the technical components, spatial & temporal coverage, and data quality of each data set. The data scoring tables are included in the Montana DEQ's "Sufficient Credible Data for Making Beneficial Use Support Determinations" guidance document. The DEQ's tables are based on tables compiled by the Intergovernmental Task Force on Monitoring Water Quality (TMF) which are included in the EPA's 1997 305(B) Report Guidelines.

2

DRINKING AND CT RECREATION SUFFICIENT CREDIBLE DATA-SCORING TABLES

WATERBODY NAME	GRANITE CR
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Drinking Water Data Table

Level of Information		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
Insufficient Data	X	Probable impairments to drinking water were not measured.		Limited temporal coverage (less than quarterly sampling for <3 yrs).		Data precision & sensitivity is low or unknown.		Data does not reflect current conditions.
		Impairments are inferred.		Data not collected at critical times.		QC protocols not followed or indicates contamination.		
		Probable causes of impairment were not documented.		Limited spatial coverage that does not adequately target probable impairments (e.g., one location).		Detection limits are too high.		
				Limited water quality data with no exceedences of standards, however, sediment data indicates contamination and/or probable sources of impairment are located in the water shed.		Samples not properly preserved.		
Sufficient Credible Data		Total recoverable metals were measured.		Drinking water quality standards are exceeded.		Data precision & sensitivity is moderate.		Data likely reflects current conditions.
		Total & dissolved metals were measured.		A sufficient number of parameters were analyzed.		QA/QC protocols are followed.		There have not been any significant changes in activities occurring in the watershed since the data was collected.
		Organic compounds were measured where contamination is suspected.		At least quarterly sampling or sampling sufficiently targets critical time periods for >2yrs.		Low detection limits.		
		Sampling & analysis includes sediment.		Good spatial coverage or well-targeted sampling location(s).				
		Probable sources of impairment were documented.		Limited water quality data with no exceedences of standards; however, sediment data does not have elevated metals and/or organic compounds and there are no probable sources of impairment located in the watershed.				

Drinking Water Comments	
	insufficient; no water chemistry data available

1

Contact Recrea[obscured] a Tables for Lakes and Streams (Swimming & Boating)

Level of Information	Technical Components	Spatial/Temporal Coverage	Data Quality	Data Currency
Insufficient Data	Observations of algae blooms, odors, turbidity, aesthetics, etc., without documentation.	Very limited water chemistry or fecal coliform data.	Data precision & sensitivity is low or unknown.	Data does not reflect current conditions.
	Observations made concerning flows or water levels, without documentation.	Data not collected at critical times such as during the summer.	QA/QC protocols were not followed.	
	Observations made concerning surface scums, pollution, toxins, etc. without documentation.	Limited spatial coverage that does not adequately target probable causes of impairments (e.g., one location).	Samples not properly collected, preserved, or exceed holding times.	
		Limited temporal cover.	Poor documentation.	
Sufficient Credible Data	Observations of algae blooms, odors, turbidity, aesthetics, etc. were well documented.	Good temporal coverage of observations, photo documentation, fecal-coliform data, etc.	Data precision & sensitivity moderate.	It is likely that the data reflects current conditions.
	Documentation includes photos.	Data & observations are targeted during the summer months.	QA/QC protocols were followed.	There have not been any significant changes in activities occurring in the watershed since the data was collected.
	Probable sources of impairment identified; probable causes of impairment measured or well documented (toxins, dewatering, etc).	Good spatial coverage or well targeted sampling location(s).	Low detection limits.	
	Chlorophyll a data collected.	Limited water quality data or documentation; however, data indicates severe impairment.		
	Fecal coliform data collected.			
	Information concerning beach closures.			
	Sechii disk data (lakes).			
	Long-time local residents provide similar historical perspectives regarding their observation of changes in water quality over time.			

Contact Recreation Comments	
	insufficient; no data relevant to contact recreation available; no water chemistry data available

2

AQUATIC LIFE /FISHERIES SUFF[illegible]T CREDIBLE DATA-SCORING TABLES

TOTAL SCD SCORE	6
BIO SCORE	3
HABITAT SCORE	3
CHEM./PHYS. SCORE	0

WATERBODY NAME	GRANITE CR
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Biology Data Table

Score		Technical Components		Spatial/Temporal Coverage		Data Quality		Data Currency
1		Visual observations of biota were made with no true assessment.		Very limited monitoring.		Data precision and sensitivity is very low or unknown.		Data is not relevant; biological communities may have changed significantly since the assessment was made.
		Simple documentation.		Data is extrapolated from other sites.		Qualified professional does not provide any oversight.		
		Unable to make a comparison to reference condition.				Poor taxonomic resolution.		
		Relative abundance data of fish that is not suppplemented with quantitative data or can not be interpreted by a qualified professional.						
		Fish creel surveys with limited supplemental information.						
2		Only one assemblage was assessed (e.g., RBP protocols).		Limited to a single sampling.		Data precision and sensitivity is low to moderate.		Data can be used to give a historical perspective for approximating reference condition or trends.
		Probable sources and causes of impairment are documented.		Limited sampling for site-specific studies.		Data was collected following appropriate protocols; however individuals had limited training.	x	**It is unlikely that the biological communities have changed significantly since the survey was conducted.**
		Reference condition can be approximated.				Qualified professional provided oversight.		
		Relative fish abundance data that can be interpreted by a qualified professional or also includes quantitative fish density.				Good taxonomic resolution.		
3	x	**Two assemblages assessed or one assemblage with quantitative (e.g., biomass) measurements following SOPs.**	x	**Monitoring during a single season the norm.**	x	**Data has moderate precision and sensitivity.**		Data was collected recently or it is very unlikely that the biological community has changed significantly since the survey was conducted.
		Often includes biotic index interpretations.		Monitoring may include site specific studies; however, also has limited spatial coverage of the stream reach.		Qualified professional performs survey or provides training; individual making the survey is well trained.		
	x	**Fisheries data often includes information about growth rates, age class and condition; The entire fish assemblage is targeted.**			x	**Qualified professional performs the survey.**		
		Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.				Detailed taxonomic resolution.		
4		Two or more assemblages assessed and often includes quantitative measurements following SOPs.	x	**Surveys conducted for multiple years and/or seasons.**		High precision and sensitivity.		Data is current; There is no doubt that the biological survey reflects current conditions.
		Reference condition is well understood and is used as the basis of the assessment.		Broad coverage of sites.		Assessment performed by a highly experienced qualified professional.		
		Often includes biotic index interpretations.		Often uses targeted or probabilistic design.				

Biology Comments

fish data collected over a period of several years; the entire assemblage is often targeted; data concerning redds, spawning habitat and juvenile growth rates included in many reports; probable sources of impairment (ie sediment loading) identified

1

emistry Data Table *(Includes Toxicity Testing)*

Score	Technical Components	ial/Temporal Coverage	Data Quality	Data Currency
1	Best professional judgment based on land use data or source location.	Low ... and temporal coverage; limited data at critical periods.	Data precision and sensitivity is very low or unknown and data appears to be an outlier (suspect).	Data does not reflect current conditions.
	Chemical parameters analyzed are limited and do not provide sufficient information concerning probable causes of impairment.	Limited period of record (e.g., one day).	High detection limits make the data difficult or impossible to interpret.	Data can only be used for determining trends or reference condition.
	Data extrapolated from an upstream or downstream station where homogeneous conditions are expected.		QC protocols indicate contamination, etc.	
			QA/QC protocols were not followed.	
2	Usually grab or composite water quality samples.	Moderate spatial and/or temporal coverage.	Data quality and sensitivity is low to moderate	Data is substantially older than ideal, but appears to be a reasonable indicator of current conditions.
	Synthesis of historical information on fish contamination levels.	Data collected at critical periods (e.g., spring, summer, spawning season).	Data was collected following appropriate protocols; however individuals had limited training.	
	Screening models based on loading data (not calibrated or verified).	Short period of record, however good spatial coverage.	Low detection limits.	
	Sediment contamination data (e.g., metal scans).	Quarterly sampling.	QC indicates there was no contamination, etc.	
	Limited chemical parameters; however probable impairment causes are targeted and probable sources of impairment documented.		Low replication used for toxicity tests.	
	Reference condition can be approximated by a qualified professional.			
	Acute or chronic WET; or acute ambient; or acute sediment tests.			
3	Series of grab or composite samples (diurnal coverage as appropriate).	Broad spatial and temporal coverage of site with sufficient frequency and coverage to capture acute events.	Data has moderate precision and sensitivity.	Data is older than ideal, but there are no indications that the condition it reflects have changed significantly.
	Calibrated models	Typically monthly sampling during key periods.	Qualified professional provides training; the individual collecting the samples is well trained.	
	Width/depth integrated sampling.	Lengthy period of record (sampled over a period of months for >2 years).	Qualified professional collected samples; data is analyzed in a competent laboratory that uses methods with low detection limits.	
	Combination of two or more of the following analyses; water column, sediment, chlorophyll, toxicity testing, or bioaccumulation data.		QC documents where there are no sampling or analytical errors.	
	Reference condition can be determined with reasonable confidence and used as a basis for assessment.		Moderate replication used for toxicity tests.	
	2-3 acute or chronic ambient; or acute sediment; or acute and chronic WET tests for effluent-dominated systems.			
4	Combination of 3 or more of the following : water column chemistry, sediment chemistry, chlorophyll or bioaccumulation data; or toxicity testing.	Broad spatial (several) & temporal coverage (monthly sampling during key periods for >3 yrs) of site with sufficient frequency & parameter coverage to capture acute events, chronic conditions and other potential impacts.	High precision and sensitivity.	Data is current. Generally less than five yrs old and/or there is a high certainty level that conditions have not changed since it was collected.
	3 or more acute and chronic ambient tests; or acute or chronic sediment tests.		Data collected and analyzed by qualified professionals following detailed QA/QC protocols.	
			High replication used for toxicity tests.	

Chemistry Comments

no chemistry data available, however, no abandoned or recent mines are present in this drainage so anthropogenic metals contamination should not be an issue

2

LAKES AND WETLANDS SUFFICIENT CREDIBLE DATA-SCORING TABLES

TOTAL SCD SCORE	0	WATERBODY NAME	GRANITE CR
BIO SCORE		WATERBODY NUMBER	#N/A
HABITAT SCORE		HYDROLOGIC UNIT CODE	0
CHEM./PHYS. SCORE			

Biology Data Table

Score	Technical Components	Spatial/Temporal Coverage	Data Quality	Data Currency
1	Simple documentation, visual observations only (no true assessment).	Very limited monitoring.	Data precision and sensitivity is very low or unknown.	Data does not reflect current conditions.
	Unable to make a comparison to reference condition.		Qualified professional does not provide any oversight.	Data can only be used for determining trends or reference condition.
	Relative abundance data of fish that is not supplemented with quantitative data or can not be interpreted by a qualified professional.		Poor taxonomic resolution.	
	Fish creel surveys with limited supplemental information.			
2	Only one biological assemblage was surveyed or observed (usually fish or algae); includes sufficient documentation that can be interpreted by a qualified professional.	Limited to a single sampling.	Data precision and sensitivity is low to moderate.	Data is substantially older than ideal, but there is reason to believe that it is a good indicator of current conditions.
	Probable sources and causes of impairment are documented.	Limited sampling for site-specific studies.	Data was collected or observations were made following appropriate protocols; however individuals had limited training.	
	Reference condition can be approximated by a qualified professional.		Qualified professional provided oversight.	
			Good taxonomic resolution.	
3	Relative abundance data or well-documented observations for 2 biological assemblages such as fish, algae, macroinvertebrates, amphibians, etc., with quantitative (e.g. population, growth rate, primary production, age class, size, condition) data for at least one assemblage.	Monitoring during a single season the norm.	Data has moderate precision and sensitivity.	Data is older than ideal, but there are no indications that the conditions it reflects have changed significantly.
	May includes biotic index interpretations.	Monitoring may include site specific studies but also has limited spatially coverages.	Qualified professional performs survey or provides training; the individual making the survey is well trained.	
	The entire fish assemblage may not be targeted, however all fish species sampled were identified.		Qualified professional performs the survey or makes observations	
	Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.		Detailed taxonomic resolution.	
	The entire fish assemblage may not be targeted, however all fish species sampled were identified.			
4	Two or more assemblages were surveyed and assessed; includes quantitative measurements for at least two assemblages following detailed SOP's.	Surveys conducted for multiple years and/or seasons.	High precision and sensitivity.	Data is current. Generally it is less than five yrs old, and/or there is certainty that the conditions have not changed since it was collected.
	Reference condition is well understood and is used as the basis of the assessment.	Broad coverage of sites.	Assessment performed by a highly experiencedprofessional.	
	The fish survey was designed to sample the entire fish assemblage	Often uses targeted or probabilistic design.	Detailed taxonomic resolution.	
	Often includes biotic index interpretations.			

Biology Comments

Chemistry Data Table(Includes Toxicity Testing)

Score	Technical Components	Spatial/Temporal Coverage	Data Quality	Dat[illegible]ncy
1	Best professional judgment based on land use data or source locaitons.	[illegible] & temporal coverage - limited data at critical periods.	Data precision & sensitivity is very low or unknown & data appears to be an outlier (suspect).	Data does no[illegible] conditions.
	Limited chemical analyses which do not provide sufficient inoformation concerning probable causes of impairment.	Limited period of record (e.g., one day)	High detection limits make the data difficult to interpret.	Data can only be used for determining trends or reference condition.
	Data extrapolated when homogeneous conditions are expected.		QA/QC protocols not followed.	
2	Usually grab or composite water quality samples.	Moderate spatial and/or temporal coverage.	Data quality & sensitivity is low to moderate.	Data is substantially older than ideal, but there is reson to believe that it is a good indicator of current conditions.
	Screening models based on loading data (not calibrated or verified).	Data collected at critical periods (lakes sampled near turnover, late winter and/or mid-summer; wetlands sampled in the spring or summer).	Data was collected following appropriate protocols; however field personnel had limited training.	
	Sediment contamination data (e.g., metal scans).	Short period of record; however good spatial coverage.	Low detection limits.	
	Chemical parameters limited; however probable causes of impairment were targeted; probable sources of impairment were documented.	Quarterly sampling or targeted seasonal-sampling.	QC indicates there was no contamination or other problems.	
	Reference condition can be approximated by a professional.	Several parameters often collected over several years (e.g., Secchi depth).	Low replication used for toxicity tests.	
	Acute or Chronic WET; or Acute ambient; or acute sediment tests.			
	Synthesis of historical information on fish contamination levels for lakes.			
	N/P ratios calculated for lakes.			
	Trophic status determine for lakes using at least 2 of the following ; transparency, primary production, phytoplankton density and/or biomass,TOC, total nitrogen, total phosphorus or chlorophyll a.			
3	Series of grab or composit samples (depth integrated & diurnal coverage as appropriate).	Broad spatial & temporal coverage of site with sufficient frequency & coverage to capture acute events (lakes sampled near turnover; late winter or mid summer; wetlands samped in late winter/early spring & mid-summer.	Data has moderate precision & sensitivity.	Data is older than ideal, but there are no indications that the condition it reflects have changed significantly.
	Calibrated models.	Typically monthly sampling during key periods.	Qualified professional provides training; the individual collecting samples is well trained.	
	Combination of two or more analyses of the following: water column, sediment, chlorophyll; toxicity testing; primary production; bioaccumulation.	Lengthly period of record (sampled over a period of months for >2yrs).	Qualified professional collects samples; Data is analyzed in a competent laboratory that uses methods with low detection limits.	
	Reference condition can be determined with a reasonable degree of confidence and used as a basis for assessment.		QC documents that there are no sampling or analytical errors.	
	2-3 acute or chronic ambient; or acute sediment; or acute and chronic WET tests for effluent dominated system.		Moderate replication used for toxicity tests.	
	Trophic status determined using Secchi depth or transparency, total phosphorus, and chlorophyll a ; includes a dissolved oxygen/temperature profile(s) for lakes.			
	N/P ratios calculated for lakes.			

2

4	Combination of three or more of the following: water-column chemistry, sediment chemistry, chlorophyll *a* , primary production, bioaccumulation data, or toxicity testing.	Broad spatial (several) & temporal coverage (mo[illegible] sampling during key periods for >3 yrs) of site[illegible] sufficient frquency & parameter coverage to ca[illegible] acute events, chronic conditions & other poten[illegible] impacts.	High precision & sensitivity.	Data is current. Generally it is less than 5 yrs old, and /or there is certainty that conditions have not changed since it was collected.
	Includes trophic status, dissolved oxygen profiles & N/P ratio (lakes) >3 acute & chronic ambient tests; or acute or chronic sediment tests.		Data collected & analyzed by qualified professionals following detailed QA/QC protocols.	
	Includes sediment core sampling.		High replication used for toxicity	

Chemistry Comments

Habitat/Physical Data Table

Score	Technical Components	Spatial/Temporal Coverage	Data Quality	Dat[illegible]ncy
1	Visual observations of habitat characteristics with no true assessment.	[illegible] visits; assessments are only made at limited areas.	Assessment precision & sensitivity is very low or unknown.	Data does no[illegible]t conditions.
	Simple documentation of practices that might alter habitat.		Assessment was not conducted by trained individual(s).	Data can only be used for determining trends or reference condition.
	No attempt to compare to reference condition; observed impacts are likely to be natural.			
2	Visual observations of habitat characteristics or impairments (e.g., shoreline erosion, fluctuating water levels, siltation, riparian & aquatic vegetation, grazing, buffer zones, spawning areas, wildlife habitat/use) were made with simple assessment.	Limited to annual visit & non-specific to season.	Assessment precision & sensitivity is low.	Data is substantially older than ideal, but there is reason to believe that it is a reasonable indicator of current conditions.
	Use of landuse maps to characterize watershed condition; probable impairment causes & sources documented.	Limited spatial coverage.	Assessment was undertaken following appropriate protocols; however individuals had limited training.	
	Reference condition can be approximated by a qualified professional.	Site- specific studies.	Qualified professional only involved through correspondence.	
3	Use of visual-based habitat assessment following SOPs; may include a detailed interpretation.	Assessment during a single season the norm.	Data has moderate precision & sensitivity.	Data is older than ideal, but there are no indications that the condition it reflects have changed significantly.
	Documentation includes photographs.	Assessment is broad; often covering the entire water body.	Qualified professional provides training; the individual making the assessment is well trained.	
	Sources & causes of impairment are well documented & understood.		Qualified professional performs the assessment & makes interpretations.	
	Information concerning surrounding land-use and/or reservoir management activities are used to supplement assessment.			
	Reference condition can be determined with a reasonable degree of confidence & used as a basis for assessment.			
4	Assessment includes quantitative measurements of selected parameters.	Assessment is broad; often covering the entire water body, data collected from multiple years.	High precision & sensitivity.	Data is current. Generally it is less than 5 yrs old, and/or there is certainty that conditions have not changed since it was collected.
	Aerial photographs, satellite images or infrared photographs are used as part of the assessment.	Aerial surveys that are ground-truthed.	Assessment was performed by a qualified professional following detailed protocols.	
	Detailed studies conducted to determine impacts to habitat caused by dam operations, etc.			
	Reference condition is well understood & is used as the basis of the assessment.			

II. BENEFICIAL USE-SUPPORT DETERMINATION: DATA MATRIX

Section 1 of 3

WATERBODY NAME	Granite Creek
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Spatial Layout of Data-Biological

Upstream

Document Number & Code	Data Parameter	Site/Reach Name	Site/Reach Name	Site/Reach Name
		From headwaters to mouth (M. Fk. Flathead River)		
	I. Biological Data			
	A. Fisheries Data			
1F	*1984 Report*	westslope cutthroat trout are uncommon in the upper reach and common in the lower reach; the genetic value for both reaches is 2, indicating the stream contains a pure population of trout and, based on visual examination, no contaminating species exist; the habitat value for both reaches is G, meaning this stream offers the greatest or highest value habitat		
2F	*1986 Report*	bull trout redd counts: 14 in 1979, 34 in 1980, 14 in 1981, 34 in 1982, 31 in 1983, 47 in 1984, 24 in 1985		
3F	*1987 Report*	see comments for 2F; there were 37 bull trout redds in 1986		
4F	*1989 Report*	median percentage of sediments < 6.35 mm:44.6% in 1982, 13% fry survival rate; 50.6% in 1986, 4% fry survival rate; 47.6% in 1987, 5% fry survival rate; 44.6% in 1988, 6% fry survival rate		
5F	*1999 Report*	1980 catch data: 184 westslope cutthroat- mean length = 9.3 in; bull trout redd counts: 34 in 1987, 32 in 1988, 31 in 1989, 21 in 1990, 20 in 1991, 16 in 1992, 9 in 1993, 18 in 1994, 25 in 1995, 4 in 1996, 12 in 1997, 22 in 1998; median percentage of sediments < 6.35 mm: 45.2% in 1989, 33.0% in 1990, 37.2% in 1991, 41.4% in 1992, 36.0% in 1993, 33.5% in 1994, 34.8% in 1995, 33.6% in 1996, 32.5% in 1997; fishery habitat has been improving since 1992- sediment percentages smaller than 6.35 have been decreasing (redd counts have fluctuated over the past few years, but this could be due to natural changes in flow)		
7F	*1988 Report*	no useful information		
8F	*1989 Report*	no useful information		
11F	*1991 Report*	no useful information		
14F	*1998 Report*	population is functioning at an unacceptable risk for growth/ survival and population size- bull trout numbers are dependent on Flathead Lake bull trout and numbers are slowly declining in the lake; life history diversity/ isolation and persistance/ genetic integrity is functioning at risk- migratory form is present in depressed numbers (if this form is lost, recolonization is unlikely), no introgression has been documented (no potential for hybridization exists since brook trout are not present in the watershed); substantial genetic divergence is present throughout other Flathead watersheds and tremendous predation/competition with lake trout is occurring throughout Flathead Lake- probability is low that the current bull trout population can persist		
12F	*MRIS Reports*	the mouth to Challenge Creek is designated as a NWPPC Fisheries Protected Area (bull trout and westslope cutthroat present and stream contains essential spawning habitat); bull trout common from mouth to Challenge Creek, genetics are pure (based on electrophoresis), stream used for migration, spawning/ rearing, and best habitat; westslope cutthroat uncommon from mouth to Challenge Creek, population is potentially pure with no record of contaminating species, stream used for rearing/migration and best habitat; mountain whitefish present; bull trout population is 100% pure (0% hybridization) based on 1993 analysis of allozymes from 17 fish		
6F	*1981 Report*	no useful information		
9F	*1982 Report*	no useful information		
	B. Macroinvertebrate Data			
	C. Periphyton Data			
	1. Algae			
	2. Chlorophyll a			

1

	D. Bacteriological Data			
	E. Wildlife			

Section 2 of 3

WATERBODY NAME	Granite Creek
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Spatial Layout of Data-Habitat

Upstream

Document Number & Code	Data Parameter	Site/Reach Name	Site/Reach Name	Site/Reach Name
	II. Habitat Data			
	A. Instream/Riparian Habitat and Physical Features			
10RPF	*1991 Report*	1989 assessment: **Reach I (mouth to just downstream of cutting unit S. Sec.7)**: reach scored 70% (moderate impairment- partial support), deep gully erosion present, extensive pool filling, large slumping banks, high flow damage to vegetation, some channel scour; **Reach II (just downstream of cutting unit S. Sec.7 to confluence of Challenge and Dodge Creeks)**: reach scored 71% (minor impairment, partial support), some high water damage to vegetation, channel unstable- scouring and channel migration present, sediment in stream believed to be result of runoff from several logging roads in the watershed		
13RPF	*1989 DEQ Stream Reach Assessment*	results from this assessment were outlined in 10RPF; interestingly, the 1989 assessment scored Reach I as 78% (minor impairment) and Reach II as 80% (full support, but threatened)- this variation in scoring between the 1991 report and the 1989 assessment is the result of modifications to the ranking criteria of the 1989 field assessment form (changes were made to fit the most recent edition (1991) of the field form)		
14RPF	*1998 Report*	habitat access, woody debris, and off channel habitats were all considered to be functioning appropriately for beneficial uses; bank stability was functioning at risk because several areas of unstable banks and slumping were present; pool frequency was functioning at risk (pool habitat ranged from 4% to 15% of the entire stream); peak flow was functioning at risk because a 7.5% increase in peak flow is predicted due to roading and harvest activities (bedload movement is present throughout stream) ← how assessed?		
12RPF	*MRIS Report*	Reach I (mouth to unnamed trib.): subsurface cover = fair; gradient = 1.7; 4% pools, 24% run, 46% riffles, 26% pocket water; Reach II (unnamed trib. to Challenge Creek): gradient = 1.0; 15% pools, 41% run, 44% riffles, 0% pocket water		
	B. Photo Points			
	C. Land Use			

add pool habitat to target

3

Section 3 of 3

WATERBODY NAME	Granite Creek
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Spatial Layout of Data-Physical and Chemical

Upstream

Document Number & Code	Data Parameter	Site/Reach Name	Site/Reach Name	Site/Reach Name
	III. Physical & Chemistry Data			
	A. Physical Data			
	1. Quantitative data			
6P	*1981 Report*	no useful information		
	2. Radiological data			
	3. Rosgen Type			
	B. Water Chemistry			
	1. Major nutrients			
	2. Metals			
	3. Common ions, pH, misc.			
	4. Toxicity tests/Bioaccumulation			
	C. Benthic sediment data			
	D. Organics			

III. SITE-SPECIFIC IMPAIRMENT LEVEL

WATERBODY NAME	GRANITE CR
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Overall Condition of Each Site/Reach

Upstream

	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name	Site/Reach Name
Site/Reach Condition					
Comments					

IV. WATERBODY SEGMENT BENEFICIAL-USE DECISIONS

WATERBODY NAME	GRANITE CR
WATERBODY NUMBER	MT76I002_010
HYDROLOGIC UNIT CODE	17010207

Beneficial Uses	SCD *(yes/no)*	Level of Use Support *(full, partial, not, threatened)*	Comments	Test-Type Used *(Independent/W.O.E.)*
Aquatic Life	yes	partial support	BIOLOGY- moderate impairment; population believed to be declining because of low numbers in Flathead Lake; bull trout redds decreasing over past 5 years, likely caused by excessive fine sediment loading, but may be the result of natural flow fluctuations; population genetically pure with no threat of hybridization; HABITAT- moderate impairment; habitat considered partially supporting in 1991 study because of excessive sedimention from logging road run-off and past silviculture; high gradient also contributes to slumping and resulting bedload; CHEMISTRY- no chemistry data available, but metals or other chemical pollutants are not a concern for this drainage (no mining in the watershed)	I
Cold Water Fishery	yes	partial support	see above comments	I
Warm Water Fishery	N/A	N/A	N/A	N/A
Agriculture	no		need water chemistry data	N/A
Industrial	no		need water chemistry data	N/A
Drinking Water	no		need water chemistry data, including metals	N/A
Fish Consumption	N/A	N/A	N/A	N/A
Primary Contact (recreation)	no		need water chemistry data and relevant habitat data	N/A
Other				N/A

*CAUSE(S)**	*SOURCE(S)**	*METHOD(S)**
Siltation	Erosion and Sedimentation	Fish surveys
Fish habitat degradation	Bank or Shoreline Modification/Destabilization	Visual observation, may not quantify some parameters; single season; by prof.
Bank erosion	Silviculture	Ecological/habitat surveys
	Highway/Road/Bridge Construction	Monitoring data more than 5 years old

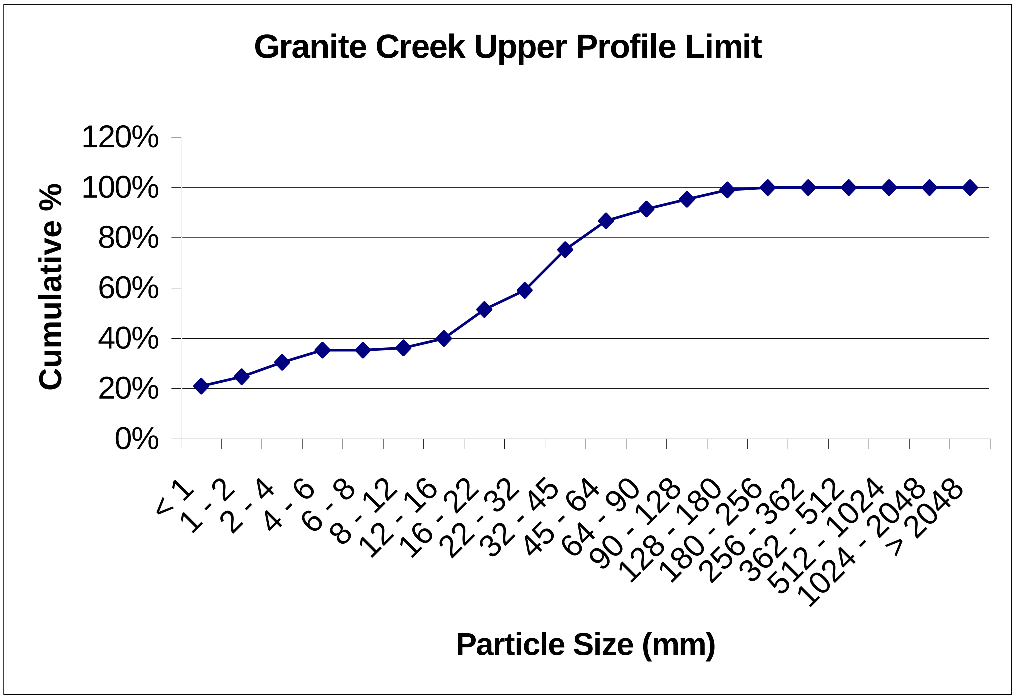
** In order of importance.*

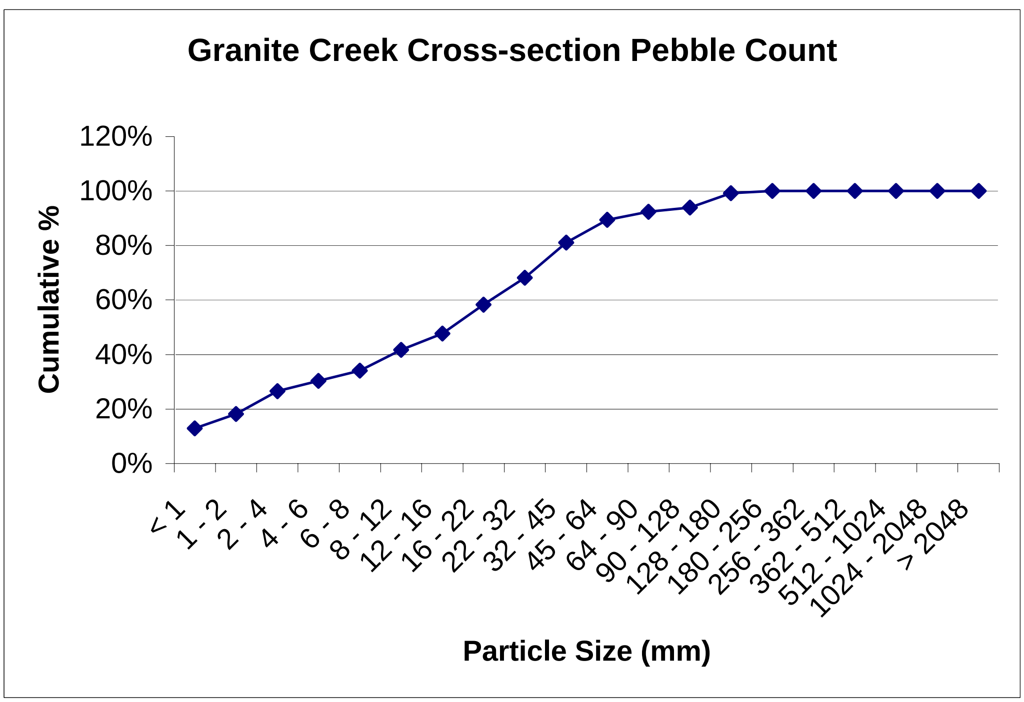
Causes, sources, and methods do not correlate.

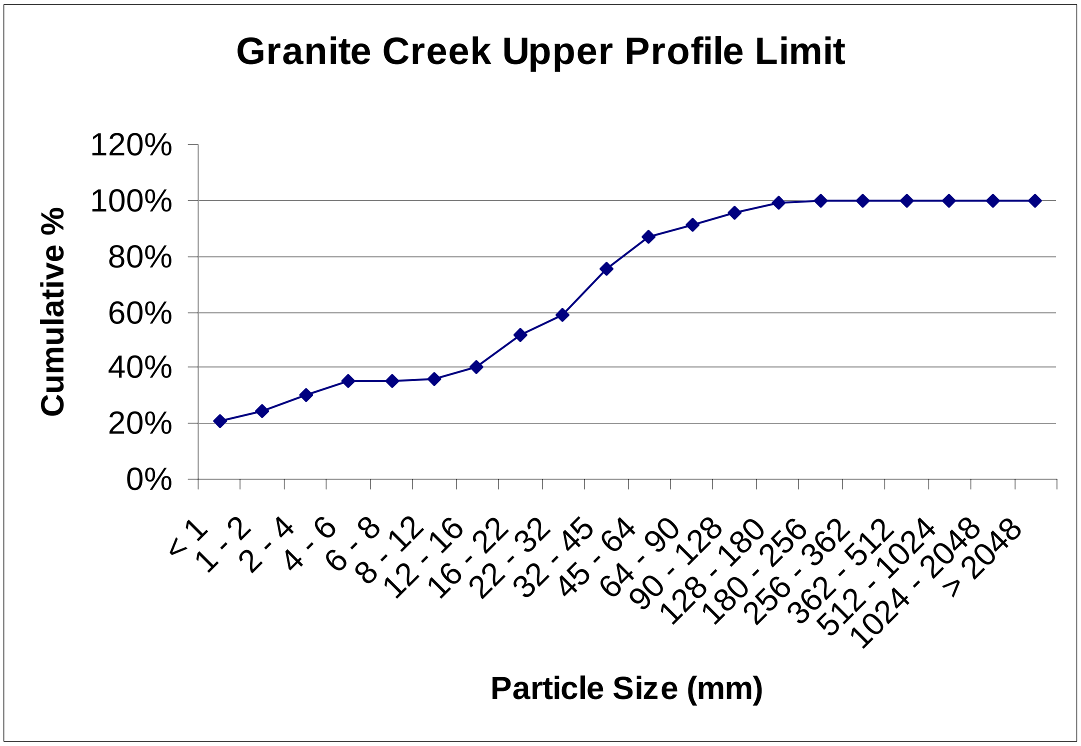
LAKES AND RESERVOIRS ONLY	
Trophic Level	
Trophic Trend	

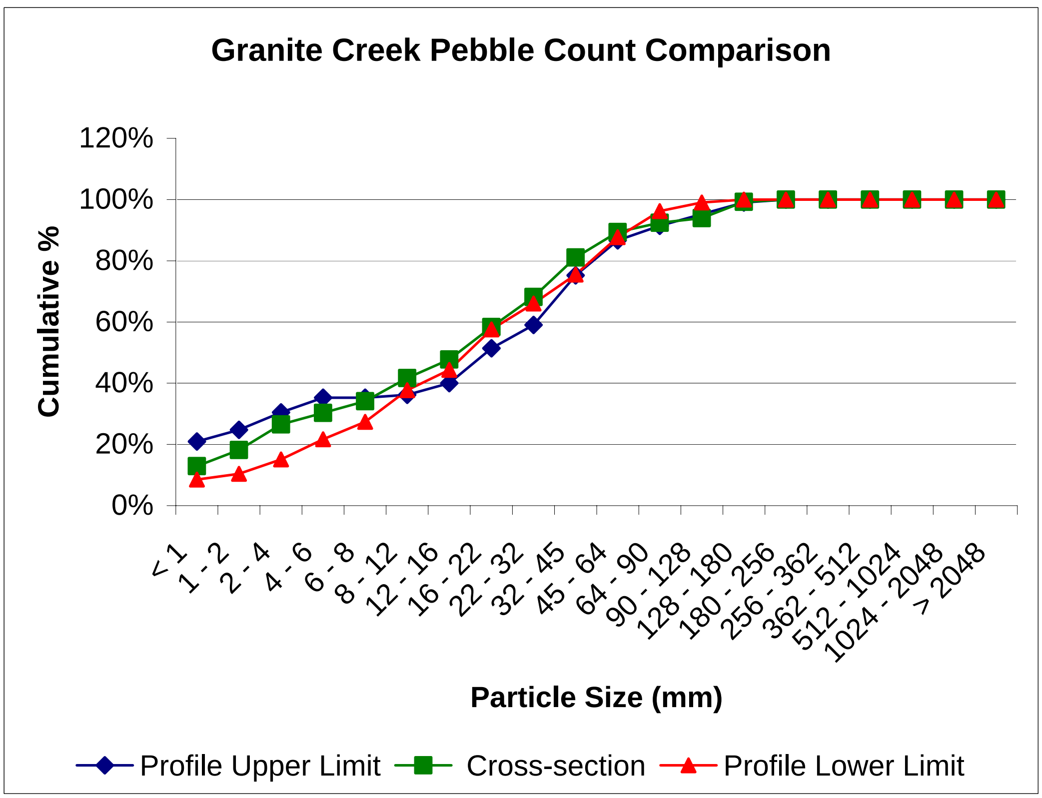
1

Pebble Counts






Granite Creek Upper Profile Limit
120%
100%
80%
60%
40%
20%
0%
Cumulative %
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)


Granite Creek Pebble Count Comparison
120%
100%
80%
60%
40%
20%
0%
Cumulative %
< 1
1 - 2
2 - 4
4 - 6
6 - 8
8 - 12
12 - 16
16 - 22
22 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
> 2048
Particle Size (mm)
Profile Upper Limit
Cross-section
Profile Lower Limit

SUBSTRATE DEQ/MDM

Date: 7/16/2003 **Site Visit Code:** Profile Upper Limit (UL)

Waterbody: Granite Creek **STORET Station ID:** 48.22650 / -113.33358

Personnel: R. Lindahl, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	22		22	20.95%	20.95%
2	Sand		1 - 2	4		4	3.81%	24.76%
3	Very Fine	GRAVELS	2 - 4	6		6	5.71%	30.48%
4	Fine	GRAVELS	4 - 6	5		5	4.76%	35.24%
5	Fine	GRAVELS	6 - 8			0	0.00%	35.24%
6	Medium	GRAVELS	8 - 12	1		1	0.95%	36.19%
7	Medium	GRAVELS	12 - 16	4		4	3.81%	40.00%
8	Coarse	GRAVELS	16 - 22	12		12	11.43%	51.43%
9	Coarse	GRAVELS	22 - 32	8		8	7.62%	59.05%
10	Very Coarse	GRAVELS	32 - 45	17		17	16.19%	75.24%
11	Very Coarse	GRAVELS	45 - 64	12		12	11.43%	86.67%
12	Small	COBBLES	64 - 90	5		5	4.76%	91.43%
13	Small	COBBLES	90 - 128	4		4	3.81%	95.24%
14	Large	COBBLES	128 - 180	4		4	3.81%	99.05%
15	Large	COBBLES	180 - 256	1		1	0.95%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			105	0	105	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/16/2003 **Site Visit Code:** Cross Section

Waterbody: Granite Creek **STORET Station ID:** 48.22633 / -113.22633

Personnel: R. Lindahl, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	17		17	12.88%	12.88%
2	Sand		1 - 2	7		7	5.30%	18.18%
3	Very Fine	GRAVELS	2 - 4	11		11	8.33%	26.52%
4	Fine	GRAVELS	4 - 6	5		5	3.79%	30.30%
5	Fine	GRAVELS	6 - 8	5		5	3.79%	34.09%
6	Medium	GRAVELS	8 - 12	10		10	7.58%	41.67%
7	Medium	GRAVELS	12 - 16	8		8	6.06%	47.73%
8	Coarse	GRAVELS	16 - 22	14		14	10.61%	58.33%
9	Coarse	GRAVELS	22 - 32	13		13	9.85%	68.18%
10	Very Coarse	GRAVELS	32 - 45	17		17	12.88%	81.06%
11	Very Coarse	GRAVELS	45 - 64	11		11	8.33%	89.39%
12	Small	COBBLES	64 - 90	4		4	3.03%	92.42%
13	Small	COBBLES	90 - 128	2		2	1.52%	93.94%
14	Large	COBBLES	128 - 180	7		7	5.30%	99.24%
15	Large	COBBLES	180 - 256	1		1	0.76%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			132	0	132	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/16/2003 **Site Visit Code:** Lower Limit

Waterbody: Granite Creek **STORET Station ID:** 48.22698 / -113.33297

Personnel: R. Lindahl, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Sum	% of Total	Cum. Total
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	9		9	8.49%	8.49%
2	Sand		1 - 2	2		2	1.89%	10.38%
3	Very Fine	GRAVELS	2 - 4	5		5	4.72%	15.09%
4	Fine	GRAVELS	4 - 6	7		7	6.60%	21.70%
5	Fine	GRAVELS	6 - 8	6		6	5.66%	27.36%
6	Medium	GRAVELS	8 - 12	11		11	10.38%	37.74%
7	Medium	GRAVELS	12 - 16	7		7	6.60%	44.34%
8	Coarse	GRAVELS	16 - 22	14		14	13.21%	57.55%
9	Coarse	GRAVELS	22 - 32	9		9	8.49%	66.04%
10	Very Coarse	GRAVELS	32 - 45	10		10	9.43%	75.47%
11	Very Coarse	GRAVELS	45 - 64	13		13	12.26%	87.74%
12	Small	COBBLES	64 - 90	9		9	8.49%	96.23%
13	Small	COBBLES	90 - 128	3		3	2.83%	99.06%
14	Large	COBBLES	128 - 180	1		1	0.94%	100.00%
15	Large	COBBLES	180 - 256			0	0.00%	100.00%
16	Small	BOULDERS	256 - 362			0	0.00%	100.00%
17	Small	BOULDERS	362 - 512			0	0.00%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock		> 2048			0	0.00%	100.00%
21	Total # Samples			106	0	106	100.00%	

Characteristic Group: PEBL-CNT

Granite Creek Historic to 2003 Pfankuch Rating Comparison

UPPER BANKS	Str.segment Date	Str.segment Date	Str.segment Date	Str.segment Date	Str.segment Date	Str.segment Date
	Unknown 23 July 1979	Unknown 5 Sept.1980		Profile Upper Limit 16 July 2003	Profile Cross-section 16 July 2003	Profile Lower Limit 16 July 2003
Landform slope	4	6		2	2	2
Mass wasting	9	9		9	6	9
Debris jam potential	6	6		6	6	6
Vegetative bank protection	5	9		6	6	6
LOWER BANKS						
Channel capacity	3	4		4	4	4
Bank rock content	6	4		6	6	6
Obstructions/flow deflectors/sediment traps	8	4		6	6	6
Cutting	12	16		12	12	12
Deposition	8	10		12	12	12
BOTTOM						
Rock angularity	10	2		2	2	2
Brightness	3	3		4	4	4
Consolid or particle packing	4	4		4	4	4
Bottom size distribution / percent stable materials	9	10		16	16	16
Scouring and deposition	12	12		18	18	18
Clinging aquatic vegetation	3	3		4	4	4
TOTALS	**95**	**102**		**111**	**108**	**111**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Granite Creek Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Challenge Unknown 15 Aug. 1979	Challenge 0.48-2.003 8 July 1987	Challenge 2.013-2.54 8 July 1987	Challenge 2.54-2.74 8 July 1987	Challenge 2.74-3.52 8 July 1987	Challenge 0.48-0.49 11 July 1988
Landform slope	2	6	6	8	6	6
Mass wasting	6	12	9	3	8	9
Debris jam potential	8	5	8	2	5	6
Vegetative bank protection	9	6	9	9	9	6
LOWER BANKS						
Channel capacity	3	3	4	1	2	3
Bank rock content	4	6	6	2	6	6
Obstructions/flow deflectors/sediment traps	6	5	8	6	3	6
Cutting	12	12	13	4	10	8
Deposition	8	10	16	4	12	12
BOTTOM						
Rock angularity	3	2	2	2	2	4
Brightness	3	3	4	1	3	3
Consolid or particle packing	6	6	6	6	4	6
Bottom size distribution / percent stable materials	8	10	14	4	10	10
Scouring and deposition	12	12	18	6	16	14
Clinging aquatic vegetation	3	3	3	1	3	3
TOTALS	**93**	**101**	**126**	**59**	**99**	**102**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Granite Creek Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Challenge 0.95-0.96 25 July 1990	Challenge 2.129-2.139 5 July 1990	Challenge 0.44-0.71 30 Oct. 1998	Dodge Unknown 15 Aug. 1979	Dodge 0.0-1.47 6 Oct. 1980	Dodge 1.47-2.11 6 Oct. 1980
Landform slope	2	2	6	2	2	4
Mass wasting	9	9	9	3	3	9
Debris jam potential	6	8	6	8	8	6
Vegetative bank protection	9	6	3	6	6	6
LOWER BANKS						
Channel capacity	2	3	3	4	4	3
Bank rock content	4	4	4	8	8	6
Obstructions/flow deflectors/sediment traps	4	6	4	5	5	6
Cutting	12	8	12	4	4	6
Deposition	10	8	12	16	16	8
BOTTOM						
Rock angularity	2	2	2	3	3	3
Brightness	2	3	2	3	2	3
Consolid or particle packing	6	4	4	6	3	2
Bottom size distribution / percent stable materials	12	8	8	12	12	14
Scouring and deposition	18	18	12	9	9	21
Clinging aquatic vegetation	3	3	2	2	2	3
TOTALS	**101**	**82**	**89**	**91**	**87**	**100**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Granite Creek Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Dodge 2.11-3.02 6 Oct. 1980	Dodge Unknown 8 Oct. 1980	Dodge Unknown 9 Oct. 1980	Dodge 0.44-1.23 7 July 1987	Dodge 1.51-2.07 9 July 1987	Dodge 2.07-2.26 9 July 1987
Landform slope	4	4	4	2	6	4
Mass wasting	9	6	6	6	5	9
Debris jam potential	6	6	6	6	5	8
Vegetative bank protection	6	6	5	4	7	11
LOWER BANKS						
Channel capacity	3	2	2	1	2	2
Bank rock content	6	5	5	6	7	4
Obstructions/flow deflectors/sediment traps	6	4	4	3	4	7
Cutting	6	8	8	8	7	12
Deposition	8	8	8	8	10	8
BOTTOM						
Rock angularity	3	2	2	2	2	2
Brightness	3	1	1	2	2	2
Consolid or particle packing	2	4	4	4	5	4
Bottom size distribution / percent stable materials	14	8	8	8	12	8
Scouring and deposition	21	12	9	12	12	12
Clinging aquatic vegetation	3	2	2	2	2	1
TOTALS	**100**	**78**	**74**	**74**	**88**	**94**

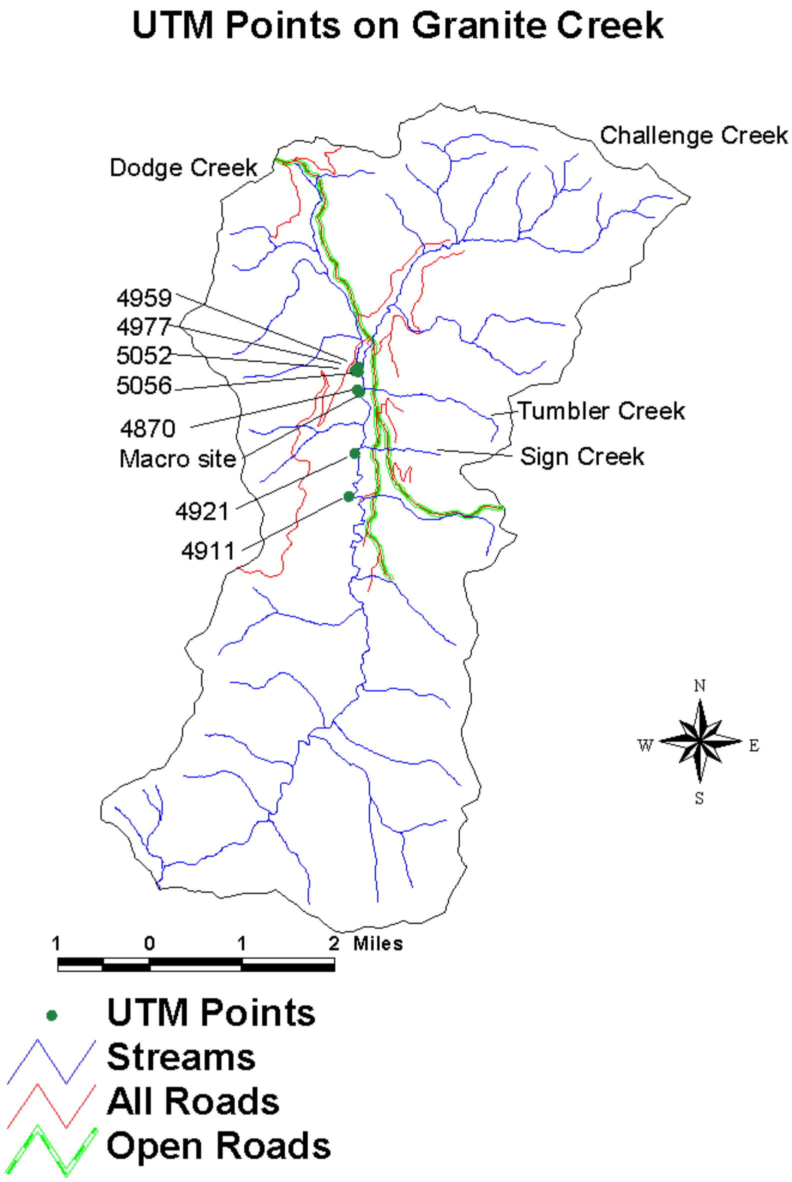
Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Granite Creek Tributary Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**
	Dodge 0.427-0.604 30 Oct. 1998	Dodge 0.942-1.177 30 Oct. 1998
Landform slope	2	2
Mass wasting	3	3
Debris jam potential	6	6
Vegetative bank protection	6	12
LOWER BANKS		
Channel capacity	3	2
Bank rock content	6	8
Obstructions/flow deflectors/sediment traps	6	4
Cutting	12	12
Deposition	12	21
BOTTOM		
Rock angularity	2	2
Brightness	3	3
Consolid or particle packing	4	6
Bottom size distribution / percent stable materials	12	12
Scouring and deposition	24	18
Clinging aquatic vegetation	3	4
TOTALS	**104**	**106**

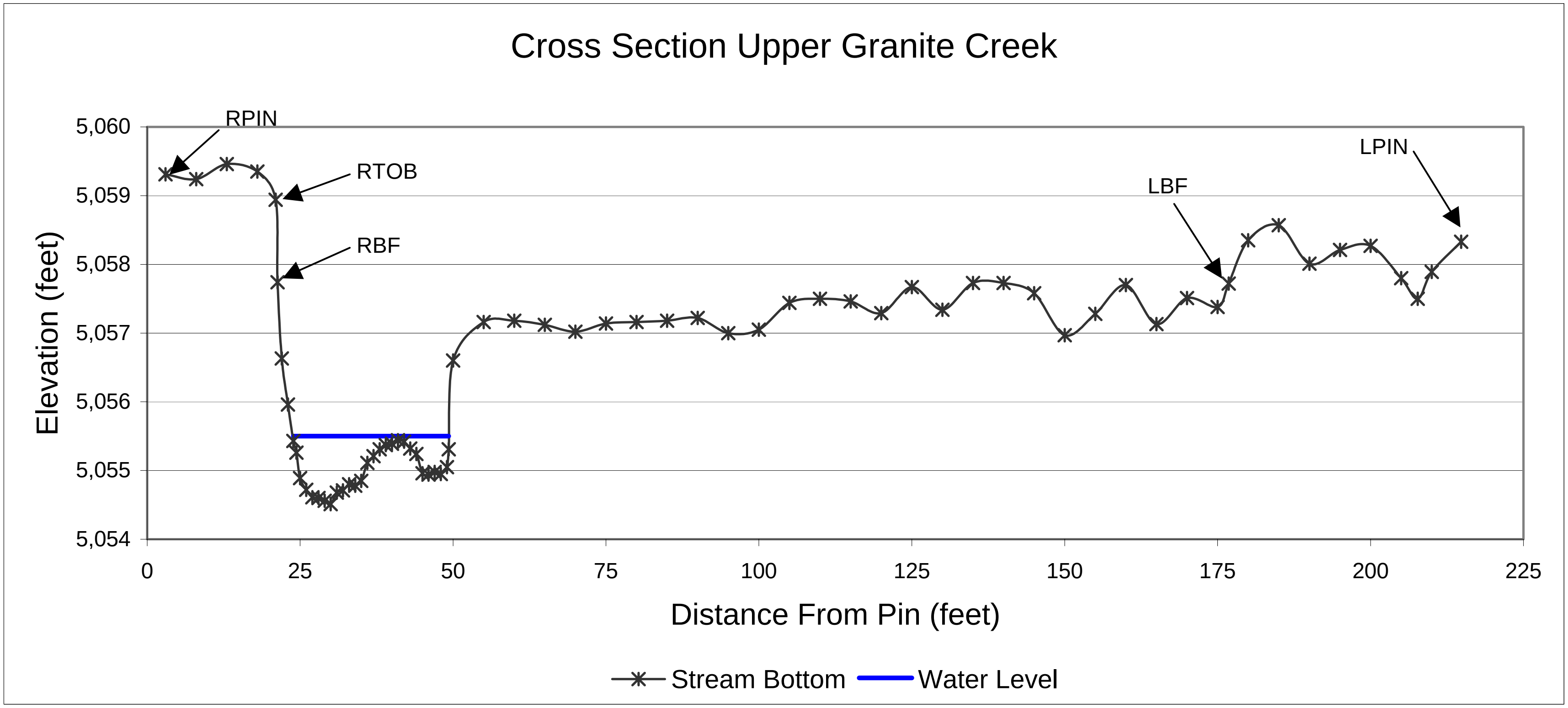
Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

UTM Points on Granite Creek



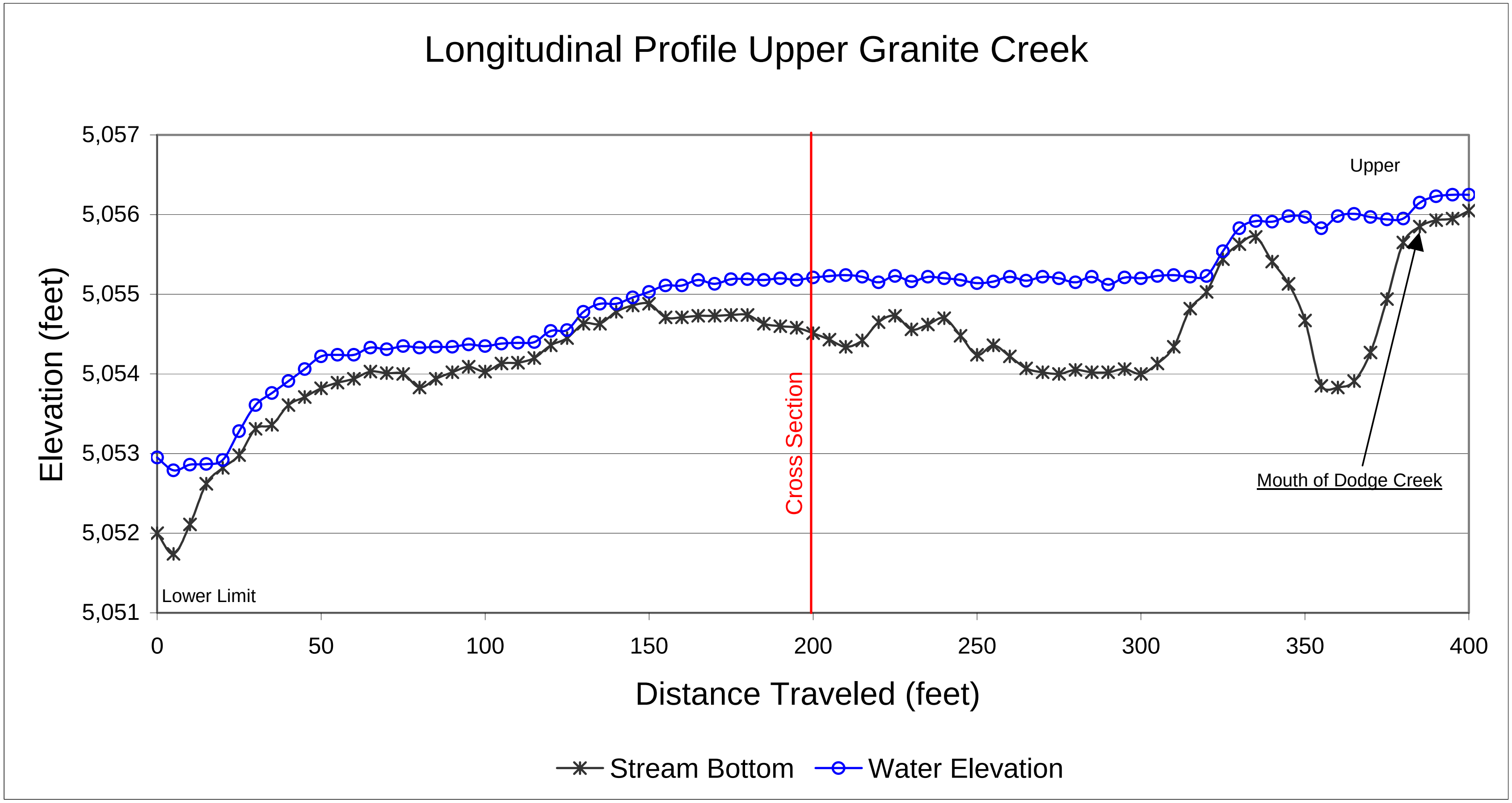
UTM Point	Latitude	Longitude	Description
4977	48.22303	-113.33252	Water disappears below Dodge Cr.
4959	48.22650	-113.33358	Profile upper limit
5052	48.22633	-113.33273	Cross-section
5056	48.22698	-113.33297	Profile lower limit
4870	48.22355	-113.33313	Water re-emerges at Tumbler Creek
MacInv	48.22313	-113.33156	Macroinvertebrate sample site
4921	48.21352	-113.33313	Water disappears below Sign Creek
4911	48.20680	-113.33412	End of walking review – Granite Cr. trailhead

Cross Section



Vertical exaggeration = 2.67

Longitudinal Profile



Vertical exaggeration = 1.5

Skyland Creek

Site Visit Forms

Attach Label Here
C202

deg minutes decimal seconds

Field Sampling Data
(One Station per page)

Trip ID ______ Date 8-23
Leader/Staff: ______

48.4881/113.6485

Waterbody Name Skyland Creek County ______ HUC ______
Station ID 02-C202 Visit # 1 Location Skyland Creek above confluence with Bear Creek
Lat 48 29 28.6 Long 113 38 90.8 Verified? ☒ By ______ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ______

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☒ Commons ☒	02-C202-W	GRAB
Sediment	☐	n/a		SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☒	02-C202	KICK HESS OTHER:
Algae/Macrophytes	☒	DEQ Aquatic Plant Form ☒		PERI-1 OTHER:
Chlorophyll a	☒		02-C202	CHLPHL-2 OTHER:
Habitat Assessment	☒	NRCS ☐ DEQ ☐ PFC ☐ EMAP ☐		Purpose:
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other	clear blue skies – low 80s°F			

Measurements:	Time: 14:06
Q / Flow (cfs)	10.5 Est. ☐
Temp: (°C)	W 9.82°C A 28.0°C
pH:	8.06
SC: (~~µmho/cm~~) uS/cm	282
~~EC: (µmho/cm)~~	
DO: (mg/L)	9.81 mg/l 86.5%
TUR: Clear ☑ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	

Comments: Altitude = 5017 feet via GPS
unbranched slimy filamentous green algae – greater coverage of algae on rocks here.
Definite evidence of 1964(?) flooding with two levels
start time = 1406
end time =

Challenge Fire in 1998 – see photos
old clearcutting / skid-trails
black lichens on rocks

AQUATIC PLANT FIELD SHEET

ate: 8/23/12 Site Visit Code: 12-C212

Waterbody Skyland Creek Site:

Personnel: Laidlaw / Schroeder / Tyler / Pridmore

Purpose: The purpose of completing this form is to estimate the percent of wetted substrates at the sampling site covered by each of the major categories of aquatic plants, to record the relative amount of accumulated growth in each category, and to note the general color and condition of plants in each category. This information will help to describe the health and productivity of the aquatic ecosystem, define nuisance aquatic plant problems, identify potential sources and causes of pollution, and document changes in the plant community over time.

Type of plant growth	Cover (%)	Amount of growth	Color	Condition
Microalgae	20	light	blue green / brown	growing
Macroalgae	45	moderate/heavy	green / brown	growing / mature
Mosses	Ø			
Macrophytes	Ø			
Bare substrate	35			
Total	100 %			

Substrates present (please rank):

rock: 1

wood: 2

sediment: 3 (sand/silt)

other (list):

1)

2)

3)

4)

5)

Explanation and Definitions

Cover: Estimate the percent of wetted substrate area colonized by each of the plant categories listed, and the percent area that is not colonized by any plants (see **Bare Substrate**, overleaf). Also, rank the types of substrates that are available for colonization by plants (1 = substrate accounting for the most area, etc.).

Amount: Record the relative amount of plant growth in each category as being **light**, **moderate**, or **heavy**. **Light** growth barely covers the substrate surface and is not immediately evident. **Heavy** growth extends almost to the water surface or beyond. **Moderate** growth is intermediate between light growth and heavy growth.

Color: The colors of aquatic plants are clues to their identity and to the health of aquatic ecosystems. Plant colors may span the spectrum of hues in the rainbow (see **Microalgae** below). Record the predominant color of the plants in each of the categories present.

Condition: Aquatic plants go through seasonal cycles of growth, maturity, and decay. The condition of a plant or group of plants will indicate the stage of this seasonal cycle. **Growing** plants show new growth and bright colors. **Mature** plants are larger but have more subdued colors because of age, epiphytes and sediment deposits. **Decaying** plants display a loss of both pigmentation and physical integrity. Enter **growing, mature, or decaying.**

Microalgae: Microalgae are microscopic algae appearing as pigmented accumulations attached to or resting upon submerged surfaces. This category commonly includes diatom "slimes" and films of green, blue-green, or euglenoid algae in depositional areas. Colors may range through shades of yellow, red, brown, green, blue and black. Included here are accumulations of "sewage fungus" (tan-gray) below sources of organic pollution, "yellow boy" (yellow-orange) below mine adits, and iron bacteria (orange-brown) in groundwater seeps and springs.

Macroalgae: Macroalgae are macroscopic algae whose individual plants or colonies are visible to the unaided eye. Macroalgae may be free-floating, or they may be attached to or resting upon submerged surfaces. Examples of macroalgae include filamentous growth forms (*Cladophora, Spirogyra, Ulothrix*), plant-like algae with leaf-like structures (*Chara, Nitella*), compact round or flattened colonies (*Nostoc, Rivularia*), gelatinous masses (*Chaetophora, Tetraspora*), and short, tubular strands (*Lemanea*). Color is highly variable, as it is with the microalgae.

Moss: Mosses are primitive plants that are intermediate in complexity between algae and higher plants. Mosses are common in cold-water habitats in western Montana. Mosses are typically green in color; the shade of green varies with plant vigor and the amount of sediment accumulation.

Macrophytes: Macrophytes or "higher plants" are distinguished from algae and mosses by their larger size and by the presence of true leaves, roots and flowers. Rooted macrophytes typically colonize areas of sediment deposition. Macrophytes may be free-floating (duckweed), submergent (pondweed), or emergent (cattails, bulrush, water lily).

Bare Substrate: Substrates may be void of plant growth because of toxic or sterile conditions or because of recently scoured or unstable substrates. Rocks in mountain lakes and streams may appear to be barren at first glance, but closer examination often reveals a very thin film of diatoms (microalgae) that feels slippery or slimy to the touch. Similarly, nearshore sediment deposits that have not been disturbed for several days will usually develop a film of microalgae. <u>**Examine these substrates closely.**</u>

STREAM CLASSIFICATION SHEET

te: 8-23-02 Site Visit Code: 02-C20 2

Waterbody Skyland Creek Site:

Personnel:

Elevation:	Rosgen Classification:
Ecoregion*:	Drainage Basin:
Stream Order:	Gradient**:
Depth:	Aspect:
Upstream Length****:	Riparian Shading:
Road density:	Drainage Density***:
Primary Source of Water:	Photograph #'s:

*Ecoregion should be determined by use of an Omernik ecoregion map.
**Gradient should be determined for the entire reach being assessed and is measured in feet per mile.
***Drainage density is measured in miles per acre upstream from site being assessed.
****Upstream length is a measure from the site to the FURTHEST point upstream.
For many of the above fields, it will be necessary to get the information from maps or other like sources.

Determine percent land use in the watershed:
Contact Conservation Districts for information on land use.

Dryland agriculture	
Irrigation	
Urban	
Grazing	
Feedlots	
Mining-surface	
Mining-subsurface	
Timber harvest	
Other (explain):	

See back of sheet

Percent land use should be determined for the entire watershed of the stream reach being assessed.

POSSIBLE SOURCES OF IMPAIRMENT

In the space following each specific land use, please comment on possible sources of impairment.

LAND USE	
Dryland crop	N/A
Irrigated crop	N/A
Grazing	N/A
Feedlots	N/A
Mining-surface	N/A
Mining-subsurface	N/A
Timber Harvest	Clearcutting from 1960s
Urban	N/A
Roads	Rte 2 250 yds to right
Natural	Challenge Fire of 1998 upstream – see photos
Other (explain):	

21.1.1.9

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Date: 8-23-02 Site Visit Code: 02-C202

Waterbody Skyland Creek Site: 1

Personnel: Schroeder | Tyler | Laidlaw

Place an "X" next to all that apply. Add additional observations in space provided for comments.

RIPARIAN ZONE/INSTREAM FEATURES

X	Forest (within Flathead / Hungry Horse)
	Field/Pasture
	Agricultural
	Residential
	Commercial
X	Roads (Hwy 2 downstream of Skyland Creek)
	Industrial
	Other (Describe):

Comments:

Local Watershed Erosion:

	None
	Little
X	Moderate
	Heavy

Comments: from Challenge fire

Local Watershed NPS Pollution:

	No evidence
X	Some potential sources
	Obvious sources

Comments: possible runoff from roads upstream + silviculture activities

	Current estimated stream width (m)
	Estimated stream width at bankfull (m)

Estimated stream depth:

	Riffle (m)
	Run (m)
	Pool (m)

	Estimated stream width at flood plain (m)
	Velocity (ft/s)
no	Is there a dam present? (Y)es or (N)o
No	Is the stream channelized? (Y)es or (N)o

Comments:

Canopy Cover:

	Open
	Partly open
X	Partly shaded
	Shaded

Comments:

SEDIMENT/SUBSTRATE

Sediment odors:

X	Normal
	Sewage
	Petroleum
	Chemical
	Anaerobic
	None
	Other (Describe):

Comments:

Sediment oils:

X	Absent
	Slight
	Moderate
	Profuse

Comments:

Sediment deposits:

	Sludge
	Sawdust
	Paper fiber
X	Sand
	Relic shells
	Other (Describe):

Comments: few sediment deposits, some sands

No	Are the undersides of stones which are not deeply embedded black? (Y)es or (N)o

ORGANIC SUBSTRATE COMPONENTS

Substrate Type	Characteristic	% comp. in sampling area
Detritus	Sticks, wood, course	5%
Muck-Mud	Black, very fine organic	20%

Comments:

WATER QUALITY

Stream Type

X	Cold water
	Cool water
	Warm water

Explain answer:

Water odors

X	Normal
	Sewage
	Petroleum
	Chemical
	None
	Other (Describe):

Comments:

Water surface oils

	Slick
	Sheen
	Globs
	Flecks
X	None

Comments:

21.1.1.5

TREAM DISCHARGE MEASUREMENT NOTES

Date: Aug 23, 2002 Site Visit Code: 02-C202

Waterbody Skyland Crk Ups Bear Crk Site:

Personnel:

Width:	16
Area:	
Velocity:	
Gage height:	
Meter type:	Marsh McBirney
Meter #:	
No. of sections:	
Flow:	

Sample method (wading, cable, through ice, boat, upstream or downstream side of bridge):

Distance from gage (ft. or miles); above or below gage?

Measurement rated excellent (2%), good (5%), fair (8%), or poor (> 8%) based on following conditions:

Comments:

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 8-23-02 Site Visit Code: 02-C002

Waterbody: Skyland Creek Site: 01

Personnel: Schroeder | Tyler | Laidlaw

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 9	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 8	9-10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 15	16-20	11-15	6-10	0-5
Comments:	Sediments in glide sections			
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
score: 15	16-20	11-15	6-10	0-5
Comments:	some deposition but no bar formation			

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 14	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 9	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments: higher floodplain terraces have some erosion potential		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 7	9-10	6-8	3-5	0-2
	Left Side 8	Average: 7		
	Right Side 6	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 8.5	9-10	6-8	3-5	0-2
	Left Side 8	Average: 8.5		
	Right Side 9	Comments:		

TOTAL SCORE: 110.5 Score compared to maximum possible: 130

$= \frac{110.5}{130}$ .85 = 85%

FIELD GUIDE FOR STREAM CLASSIFICATION

Stream Channel Classification (Level II) ....

Stream NAME: Skyland Creek

Basin NAME: ______ Drainage AREA: ______ Ac. ______ SqMi.

Location: 02-C208

Twp: ______ Rge: ______ Sec: ______ Qtr: ______ Lat. ______ Long. ______

Observers: Laidlow/Schroeder/Hyler/Pridmore Date: 8-23-02

Bankfull WIDTH (W_{bkf}) 19.00 Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 2.9 Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf} = A / W_{bkf}$)

Bnkfl. X-Section AREA (A_{bkf}) 55.1 Sq.Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width / Depth RATIO (W_{bkf} / d_{bkf}) 6.5
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 3.8 Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 72 Ft. 42 + 30
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) 3.8
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials *(Particle Size Index)* D50 77 mm. small gravel
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) .008 Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.03
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/ VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type B4 — *For reference, note: StreamType Chart & Classification Key*

TABLE 2. Level II classificaton criteria, (field form)

21

Width	Depth
0	1.7
2	2.58
4	2.94
6	3.34
8	3.36
10	3.8
12	2.74
14	2.6
16	3.06

Left Bankfull - 1.7
Right Bankfull - 2.2

right side ~ = 42'
30.5"

Substrate DEQ/MDM

m Name Skyland Station ID Date 8-23-02

Visit Code 02-TA22 Personnel Schroeder, Hyler, Laidlaw

Particle Category		Size Category (mm)	Dot and Dash Count ⁚ ‐ =3, ⊠=10	Sum	% of Total	Cum. Total
			Pebble Count			
Silt/Clay		< 1				
Sand		1-2	6	6		
Very Fine	Gravels	2-4				
Fine	Gravels	4-6				
Fine	Gravels	6-8				
Medium	Gravels	8-12				
Medium	Gravels	12-16	2	2		
Coarse	Gravels	16-22	6	6		
Coarse	Gravels	22-32	6	6		
Very Coarse	Gravels	32-45	7	8		
Very Coarse	Gravels	45-64	9	8		
Small	Cobbles	64-90	18	18		
Small	Cobbles	90-128	24	24		
Large	Cobbles	128-180	10	10		
Large	Cobbles	180-256	9	8		
Small	Boulders	256-362	5	5		
Small	Boulders	362-512		1		
Medium	Boulders	512-1024		1		
Large	Boulders	1024-2048		1		
Bedrock	Boulders	>2048		~~1~~		
# of Samples				105		

52.5

small gravel = D50

D50 : 77mm

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

Montana
12/2000

RIPARIAN ASSESSMENT WORKSHEET

me of Stream: Skyland Creek Station ID 02-C202
Team/Observers: Schroeder / Tyler / Laidlaw Date: 8-23-02
Length of Reach: 1/2 Mile Other Data

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 4 Potential Score: 6

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

ual Score: 6 Potential Score: 6

Comments sediment found in pools

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 6 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 3 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

Comments

2

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

one age class of native woody riparian species clearly absent, all others well represented. For sites with potential trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 6 Potential Score: 8

Comments missing older age class b/c of flooding

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating >_ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating >_ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating >_ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating >_ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating >_ 6

Actual Score: Potential Score:

Comments black cottonwood, goldenrod, willow, cow parsnip, alder

3

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

STREAM/PROJECT: ______ REACH I.D ______ DATE: ______

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
~~50-80% = AT RISK~~
LESS THAN 50% = NOT SUSTAINABLE

actual = 49/53 = .9245

92%

* Only in certain, specific situations can both of these receive an "N/A".

4

Montana Department of Environmental Quality
Supplemental Questions to NRCS Riparian Assessment Worksheet

The score for these questions does not have an effect on the rating above.
te: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, and/or aquatic vegetation

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream type would not support a fishery under natural conditions

Actual Score: 8 Potential Score: 8

Comments willows, black cottonwoods / alders

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by

Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 4 Potential Score: 6

Comments open areas due to past flooding events

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 4 Potential Score: 6

Comments

5

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

6

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic ganisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 6 Potential Score: 8

Comments Challenge Fire of 1998 upstream
Clearcutting from ~ 1960s – regeneration evident

Total Actual 44 Total Potential 50

44/50 = 88%

RATING $\frac{\text{Total}}{\text{Potential}}$ x 100 #DIV/0!

OVERALL RATING $\frac{\text{(Total NRCS Actual + Total MT Supplement Actual)}}{\text{(Total NRCS Potential + Total MT Supplement Potential)}}$ x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

7

Updated 4/2002

21.1.1.4

STREAM REACH ASSESSMENT FORM

Date: 8/23/02 Site Visit Code: 02-C212

Waterbody: Skyland Creek Site: Skyland Creek

Personnel: Laidlaw / Schneider / Tyler

PHOTO/SLIDE #'S:

ANSWER ALL: N/R=UNABLE TO RECORD N/A=NOT APPLICABLE

TYPE "X" IN BOX NEXT TO DESCRIPTION THAT BEST FITS EACH CATEGORY

(1) Predominant vegetation & landscape characteristics in the watershed beyond the immediate riparian zone:

Perennial vegetation, flat to rolling landscape	☐
Perennial vegetation, rolling to steep landscape	☒
Mixed perennial vegetation & annual crops, flat to rolling landscape	☐
Cropland, rolling to steep landscape	☐

Comments:

(2) Meanders:

Slight meandering--relatively straight channel with only occasional curves. Travel length is basically the same as the straight line distance	☒
Moderate meandering--easy, gradual bends in the channel path	☐
Extreme meandering--travel length of flow is greater than twice the straight line distance	☐

Comments:

(3) Flood flow width:

Floods are confined in narrow canyon with width less than twice that of channel	☐
Floods confined to a flow width of 2-3 times the width of the channel	☒
Floods are unconfined and spill out onto flat valley bottom	☐

Comments: there is history of past flooding > 5 yrs

(4) Gradient

Steep - Continuous rapids	☐
Moderate - Alternating rapids, riffles and smooth surfaced reaches	☒
Gradual - Smooth surfaced reaches with occasional riffles	☐
Flat - Very rare disruptions in smooth flat surface of stream	☐

Comments:

1.Average width of riparian zone

(> 90 ft wide) — 16-20
Varies from 15 to 90 ft — 13 11-15
(3-15 ft) — 6-10
Riparian zone absent — 1-5

Comments (e.g. potential):

2.Completeness of vegetation in the riparian zone
(Any vegetation functioning to maintain the bank)

Riparian zone intact without breaks in vegetation — 16-20
Breaks occurring intermittently. — 12 11-15
Breaks frequent with some gullies and scars every 100 - 150 ft — 6-10
Deeply scarred with active headcutting and gully formation all along reach — 1-5
Is there evidence of sediment from the upper watershed or riparian area reaching the stream channel? — (Y)es or (N)o

If yes, please describe:

Comments:

3. Characteristics of the Riparian vegetation

Diversity of perennial plant species reflects potential for site; Dense growth; good plant vigor and age diversity — 16-20
Approximately 60% of mature plant species present; plant vigor stable, density of growth mostly open (easy to walk through) — 15 11-15
Little diversity in perennial plant species, and/or age of trees; plants scattered; vigor poor — 6-10
Site is dominated by annual forbs and weeds; few perennial or climax plants present — 1-5

Comments: past flooding has scoured specific areas but regeneration is good

4. Width/Depth ratio. The point where high flow normally reaches on the bank & is most easily determined on straight channel sections where the "scoured" channel meets the "permanent" vegetation. Look for characteristics such as terracing, soil changes (rock to soil), presence/absence of vegetation or debris

Width/depth ratio <8 — 10-12
Width/depth ratio 8 to 15 — 7-9
Width/depth ratio 15 to 25 — 4-6
Width/depth ratio > 25 or stream is channelized or channel is an incised gully — 1-3

Comments: to be measured

5.Channel stability/bar formation

Little or no channel instability resulting from sediment accumulation — 10 10-12
Some gravel bars of coarse stones and well-washed debris present, little silt — 7-9
Point bars enlarging by gravel, sand and/or silt, new bars forming — 4-6
Channel divided into braids or stream is channelized — 1-3

Comments:

6.Bank erosion

' ittle or none evident, banks appear stable and are held firmly by vegetation	19	16-20
ɔsion occurring on some outside bends and channel constrictions; non-eroding banks stable		11-15
ɛrosion common on most outside bends and channel constrictions		6-10
Erosion predominant on entire channel (straight sections, inside and outside bends, etc.)		1-5

Comments: heavily dominated by willows in this reach

(Answer ONE, either 7a. OR 7b.)

7a. Stream bottom - (For Fast moving/Riffle dominated streams)

Stony bottom of several sizes packed together, interstices obvious	18	16-20
Stony bottom easily moved, with little silt		11-15
Bottom of silt, gravel and sand, stable in places		6-10
Uniform bottom of sand and silt loosely held together, stony substrate absent		1-5

7b. Stream bottom - (For Slow moving/Pool dominated streams)

Mixture of substrate materials with gravel and firm sand prevalent; vascular root mats and submerged vegetation common		16-20
Mixture of soft sand, mud or clay; mud may be dominant; some vascular root mats and submerged vegetation present		11-15
All mud or clay, or channelized with sand bottom; little or no submerged vegetation		6-10
Hardpan clay or bedrock; no vascular root mat or submerged vegetation		1-5

Comments:

ı. Riffle/pool spacing - (For Fast moving/Riffle dominated streams)

Distinct, occurring at intervals of 5-7x stream width	19	16-20
Irregularly spaced, 8-15x stream width		11-15
Long pools separating short riffles, meanders absent, 16-25x stream width		6-10
Meanders and riffles/pools absent or stream channelized, >25x stream width		1-5

8b. Riffle/pool characteristics - (For Slow moving/Pool dominated streams)

Even mix of deep, shallow, large and small pools		16-20
Majority of pools large and deep, very few shallow pools		11-15
Shallow pools more prevalent than deep pools		6-10
Majority of pools small and shallow or pools absent		1-5

Comments:

9.Aquatic plant growth

Not apparent, but rocks or other submerged objects feel slippery		10-12
In small patches or along channel edges		7-9
In large patches or discontinuous mats	6	4-6
Mats cover bottom (hyper-enriched conditions) or plants not apparent and rocks not slippery (stream devoid of algae because of toxic conditions)		1-3

Comments:

ɔ.Turbidity

Clear	12	10-12
Slightly off color		7-9
Opaquem (can see through)		4-6
Cloudy (can't see through)		1-3

Color:

6.Bank erosion

' ittle or none evident, banks appear stable and are held firmly by vegetation	19	16-20
ɔsion occurring on some outside bends and channel constrictions; non-eroding banks stable		11-15
ɛrosion common on most outside bends and channel constrictions		6-10
Erosion predominant on entire channel (straight sections, inside and outside bends, etc.)		1-5

Comments: heavily dominated by willows in this reach

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Comments:

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Majority of pools large and deep, very few shallow pools		11-15
Shallow pools more prevalent than deep pools		6-10
Majority of pools small and shallow or pools absent		1-5

Comments:

9.Aquatic plant growth

Not apparent, but rocks or other submerged objects feel slippery		10-12
In small patches or along channel edges		7-9
In large patches or discontinuous mats	6	4-6
Mats cover bottom (hyper-enriched conditions) or plants not apparent and rocks not slippery (stream devoid of algae because of toxic conditions)		1-3

Comments:

ɔ.Turbidity

Clear	12	10-12
Slightly off color		7-9
Opaquem (can see through)		4-6
Cloudy (can't see through)		1-3

Color:

Is rain or runoff influencing turbidity levels today? N (Y)es or (N)o

Comments:

11. Water surface oils

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

(Place "X" next to all that apply)

Slick:

Sheen:

Flecks:

(Please describe):

Comments:

12. Materials other than sediment on channel bottom (e.g. iron or aluminum oxides, calcium carbonate)

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

State color:

Comments:

13. Salinization

None evident	12	10-12
Evidence of salinity is present in the watershed, but no salt crusts observed in or near the stream		7-9
Minor evidence of salts in or near the stream. Plant diversity may be reduced or dominated by salt tolerant species		4-6
Salt crusts common in or near the stream or on stream banks. Vegetation may be severely reduced due to salt		1-3

Comments:

14. Water odor

None	12	10-12
Slight		7-9
Moderate		4-6
Strong		1-3

Describe odor:

Sewage:

Petroleum:

Chemical:

Natural:

Other:

Comments:

No apparent loss (irrigation return flow may be supplementing base flow) | 12 | 10-12
Water loss noticeable, however flows are adequate to support aquatic organisms | | 7-9
Flow supports aquatic organisms, but habitat, especially riffles, is drastically reduced | | 4-6
hannel may be dry or flow low enough to preclude or severely impair aquatic organisms | | 1-3

Are irrigation diversion or return structures present? | | (Y)es or (N)o

Comments:

---

16. *Amount of fish cover (Relative % of reach with some type of fish cover)*

Extensive (> 50%) | 11 | 10-12
Moderate (25-50%) | | 7-9
Sparse (< 25%) | | 4-6
Absent or "choking" vegetation only | | 1-3

Fish cover types--(P) present, (C) common, (A) abundant, (N) none

Undercut banks: C
anging vegetation: A
Deep pools: P
ɔgs/Woody Debris: A
Boulders: C
Rootwads: C
ɩquatic Vegetation: P
Other:

Additional Comments:

ɔTAL MAXIMUM COMPARED TO MAXIMUM POSSIBLE: 195 = actual
%TOTAL: 228 = maximum

85.5%

87-100%=Non-impaired; Fully supporting
80-86%=Non-impaired; Fully supporting, but threatened
71-79%=Minor impairment; Partially supporting
55-70%=Moderate impairment; Partially supporting
0-54%=Severe impairment; Non-supporting

TOTAL MAXIMUM COMPARED TO REFERENCE STREAM:

Total Value: Note: Data should be compared to reference condition.

Reference Stream Value:

Enter value of reference stream in order to compare results from stream being assessed.

> 75%=Fully supporting
50-75%=Partially supporting
< 50%=Non-supporting

TOTAL DISCHARGE:

Date: 23 Aug 02 Site Visit Code: 02-C002

Waterbody Skyland Creek Site: above confluence with Bear Creek.

Personnel:

**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
16	0	0	0	0	0
15.25	0.15	0.26	0.75	0.1125	0.02925
14.50	0.20	0.58	0.75	0.15	0.087
13.75	0.25	0.73		0.2625	0.192
13.00	0.80	1.71		0.6	1.026
12.25	0.90	2.35		0.675	1.586
11.50	1.00	2.48		0.75	1.86
10.75	0.70	2.09		0.525	1.097
10.00	0.45	1.46		0.3375	0.493
9.25	0.85	1.42		0.6375	0.905
8.50	0.75	1.40		0.5625	0.788
7.75	0.85	1.29		0.6375	0.822
7.00	0.50	0.71		0.375	0.266
6.25	0.30	0.38		0.225	0.0855
5.50	0.45	0.62		0.3375	0.20925
4.75	0.10	1.07		0.075	0.08025
4.00	0.25	1.10		0.1875	0.20625
3.25	0.45	0.15		0.3375	0.050625
2.50	0.45	0.43		0.3375	0.14512
1.75	0.20	1.04		0.15	0.156
1.00	0.50	1.01		0.375	0.37875
0.25	0.25	0.19		0.1875	0.035625
				0	0

10.5 cfs

NOTE:
First blank is used to mark the bank.
Begin measurements from the left bank (determine left bank while looking downstream).
Initial point is often the tape reading of the waterline & has no depth or velocity to measure.
If this is the case, the first measurement is made at the first point where there is adequate depth (at least 0.2 ft) and measurable velocity.

The value for the "Distance from initial point" field is not necessarily the tape reading. Make sure it is reflective of the true distance from the bank.

If there is a sharp drop in water level near the bank, you must compensate for the discharge that is occurring near the bank. To do so, you must insert a "dummy" value in the first "distance" blank. This value should be equal to the second value (i.e. the first measurement).

** points where there is stagnant water or backflow effects, begin and end measurements at the edge of where positive flow [illegible] be measured.
[illegible]ead depths on wading rod ignoring the "pile-up" effect of water on the rod.
Velocity is measured at six-tenths depth from the water surface by moving the probe support so that the foot indicator marks
25 to 30 cross-sections are adequate to reduce the level of error.

Sections should be spaced so none contain more than 10% of the flow. Ideal measurements have less than 5% in a section.

Miscellaneous Documents

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

Cogswell Building, Rm B219, 1400 Broadway, PO BOX 4369, Helena MT 59604 Phone 444-2642

- RESULTS OF CHEMICAL ANALYSIS -

ROSIE SADA
DEQ PPAD
PHOENIX BUILDING
HELENA MT 59620

Acct #: WTMDL101
PWSID #:
Report Date: 10/24/2002

Collected: 08/23/2002
Time: 14:06
By: ROSIE SADA

Lab#: C0208-3344

Sample ID: 02-C202-W SKLAND CRK / DEQ PPAD

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
Nitrate plus Nitrite as N		0.02	mg/L	EPA 353.2	09/05/02	crs
Total Kjeldahl Nitrogen	<	0.10	mg/L	EPA 351.1	09/09/02	crs
Total Phosphorous	<	0.001	mg/L	EPA 365.4	09/12/02	crs
Chloride	<	1.00	mg/L	EPA 300.0	09/03/02	crs
Sulfate		57.4	mg/L	EPA 300.0	09/03/02	crs
[illegible]r	<	0.001	mg/L	EPA 200.9	09/30/02	gal
[illegible]ninum		0.010	mg/L	EPA 200.7	09/23/02	gal
Arsenic	<	0.001	mg/L	EPA 200.9	09/24/02	gal
Barium		0.081	mg/L	EPA 200.7	09/23/02	gal
Beryllium	<	0.001	mg/L	EPA 200.9	09/23/02	gal
Cadmium	<	0.0001	mg/L	EPA 200.9	10/01/02	gal
Copper		0.001	mg/L	EPA 200.7	09/23/02	gal
Iron		0.01	mg/L	EPA 200.7	09/23/02	gal
Manganese	<	0.005	mg/L	EPA 200.7	09/23/02	gal
Nickel	<	0.01	mg/L	EPA 200.7	09/23/02	gal
Lead	<	0.001	mg/L	EPA 200.9	09/30/02	gal
Antimony	<	0.001	mg/L	EPA 200.9	09/25/02	gal
Selenium	<	0.002	mg/L	EPA 200.9	09/30/02	gal
Thallium	<	0.001	mg/L	EPA 200.9	09/30/02	gal
Zinc	<	0.005	mg/L	EPA 200.7	09/23/02	gal
Potassium		0.500	mg/L	EPA 200.7	09/05/02	gal
Calcium		46.8	mg/L	EPA 200.7	09/05/02	gal
Magnesium		8.10	mg/L	EPA 200.7	09/05/02	gal
Sodium		2.20	mg/L	EPA 200.7	09/05/02	gal
Sodium Adsorption Ratio		0.1	(Ratio)	EPA 200.7	09/05/02	gal
Total Hardness as CaCO3		150	mg/L	EPA 200.7	09/05/02	gal
Hardness, Grains / Gallon		8.80	gr/gal	EPA 200.7	09/05/02	gal
Cation Milliequivalent		3.11	meq/L	SM 1050 A	09/11/02	
Anion Milliequivalent		2.98	meq/L	SM 1050 A	09/11/02	
Chromium	<	0.001	mg/L	EPA 200.9	09/23/02	gal
[illegible]alinity in Water		88.0	mg/L	EPA 310.2	09/03/02	jf
[illegible]rbonate as CaCO3		88.0	mg/L	EPA 310	09/03/02	jf
[illegible]otal Dissolved Solids at 180 deg. C		176	mg/L	EPA 160.1	09/04/02	jf

Approved by: [signature]

FLAGS: < = less-than
> = greater-than
* = holding time exceeded

H = above EPA limit for drinking water

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

Cogswell Building, Rm B219, 1400 Broadway, PO BOX 4369, Helena MT 59604 Phone 444-2642

- RESULTS OF CHEMICAL ANALYSIS -

ROSIE SADA
DEQ PPAD
PHOENIX BUILDING
HELENA MT 59620

Acct #: WTMDL101
PWSID #:
Report Date: 10/24/2002

Collected: 08/23/2002
Time: 14:06
By: ROSIE SADA

Lab#: C0208-3344

Sample ID: 02-C202-W SKLAND CRK / DEQ PPAD

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
Total Suspended Solids at 105 deg. C	<	1.00	mg/L	SM 2540-D	09/04/02	jf
Total Recoverable Metals Digestion		completed		EPA 200.2	09/18/02	gal
Area of Rocks		.045	m2	EPA CLPH	10/11/02	JC
Chlorophyll A		65.9	mg/m2	EPA CLPH	10/11/02	JC

Approved by:

FLAGS: < = less-than
> = greater-than
* = holding time exceeded

H = above EPA limit for drinking water

QC for Samples C0208-3342 through C0208-3346

Parameter	Original Sample #	Reported Result mg/L	Duplicate Result mg/L	Lab # of Spiked Sample	Spike Percent Recovery	Blank Value mg/L	Reference ID	Reference Actual Value mg/L	Lab Value for Reference mg/L	Reference Percent Recovery	Reference Acceptance Limits mg/L
Nitrate+Nitrite	0209-3342	0.02	0.02	0209-3342	103.0%	<0.01	ERA P074	7.78	8.30	107%	7.00-8.56
Kjeldahl Nitrogen	0209-3345	<0.1	<0.1	C0209-3346	107.0%	<0.10	ERA P074	1.68	1.71	102%	1.51-1.84
Total Phosphorous	0209-3342	<0.001	<0.001	0209-3343	109.0%	<0.001	ERA P074	0.078	0.0773	99%	0.0706-0.0862
Chloride	0209-3343	<1.0	<1.0	0209-3343	100.0%	<0.02	ERA981 #821	5.79	5.907	102%	5.21-6.37
Sulfate	0209-3343	2.56	2.95	0209-3343	99.0%	<0.05	ERA981 #821	15.2	15.638	103%	13.68-16.72
Total Suspended Solids at 105 deg. C	0209-3343	<1.0	<1.0			<1.0					
Silver	0209-3343	< 0.001	< 0.001	0209-3343	94.7%	<0.001	ERA 3438	0.0569	0.0532	93.5%	0.049 - 0.0644
Aluminum	0209-3343	0.01	0.01	0209-3343	98.9%	0.01	WS-65	1.08	1.14	105.6%	0.973 - 1.180
Arsenic	0209-3343	< 0.001	< 0.001	0209-3343	101.7%	< 0.001	ERA 3438	0.112	0.1130	100.9%	0.0896 - 0.134
Barium	0209-3343	0.111	0.112	0209-3343	109.3%	< 0.005	WS-65	0.807	0.7970	98.8%	0.686 - 0.928
Beryllium	0209-3343	< 0.001	< 0.001	0209-3343	97.3%	< 0.001	WS-65	0.00643	0.0065	101.1%	0.00547 - 0.00739
Cadmium	0209-3427	< 0.0001	< 0.0001	0209-3427	101.1%	< 0.0001	ERA 3438	0.0206	0.0194	94.2%	0.0165 - 0.0247
Chromium	0209-3343	< 0.001	< 0.001	0209-3343	97.5%	< 0.001	WS-65	0.106	0.1070	100.9%	0.0901 - 0.122
Copper	0209-3343	0.001	0.001	0209-3343	95.4%	< 0.001	ERA 3438	0.206	0.2050	99.5%	0.185 - 0.227
Iron	0209-3343	< 0.01	< 0.01	0209-3343	98.3%	< 0.01	WS-65	0.409	0.4060	99.3%	0.374 - 0.446
Manganese	0209-3343	< 0.005	< 0.005	0209-3343	97.1%	< 0.005	WS-65	0.208	0.2060	99.0%	0.193 - 0.219
Nickel	0209-3343	< 0.01	< 0.01	0209-3343	97.1%	< 0.01	WS-65	0.433	0.4240	97.9%	0.368 - 0.498
Lead	0209-3427	<0.001	<0.001	0209-3427	100.7%	<0.001	ERA 3438	0.0519	0.0480	92.5%	0.0363 - 0.0675
Antimony	0209-3427	< 0.001	< 0.001	0209-3427	103.5%	<0.001	WS-65	0.0423	0.0440	104.0%	0.0296 - 0.0550
Selenium	0209-3427	< 0.002	< 0.002	0209-3427	108.9%	< 0.002	ERA 3438	0.0236	0.0248	105.1%	0.0189 - 0.0283
Thallium	0209-3343	< 0.001	< 0.001	0209-3343	102.5%	< 0.001	WS-65	0.007	0.0070	94.2%	0.0052 - 0.00966
Zinc	0209-3343	< 0.005	< 0.005	0209-3343	94.4%	< 0.005	ERA 3438	0.709	0.7340	103.5%	0.600 - 0.850
Calcium	0209-3343	24.4	24.3	0209-3343	100.1%	< 0.10	ERA 530	101.0	100.0	99.0%	90.9 - 111
Magnesium	0209-3343	7.90	7.90	0209-3343	101.6%	< 0.10	ERA 530	65.2	63.7	97.7%	58.0 - 72.4
Potassium	0209-3343	0.30	0.30	0209-3343	107.1%	< 0.20	ERA 530	67.1	66.7	99.4%	61.1 - 73.1
Sodium	0209-3343	0.90	0.90	0209-3343	98.4%	< 0.20	ERA 530	114	112	98.2%	100 - 128
Chlorophyll A	C0208-3342	13.5 mg/m2	13.0 mg/m2			0 mg/m2					

Skyland | Granite

Habitat Access- There are no man made barriers in this watershed. FA

Embeddedness- The Flathead National Forest does not measure embeddedness. Best professional judgement is that it is FAR

Large Woody Debris- The 1981 survey indicated that debris was low. This is due to the influence of Highway 2. LWD will increase in Skyland Creek. FAR

Pool Frequency- The 1981 survey determined that the highest pool habitat was 10% in reach 2. FAR

Large Pools- The 1981 survey used a pool classification system to indicate the value of the pool as fish habitat based upon size, depth and cover. Class I or II pools were 90% in the 1981 survey in reach 2. Large pools were limited in the remaining reaches. Therefore, pool quality would be poor. FAR

Off Channel Habitats- Off channel habitats are limited. FAR

Refugia- This area would not be considered as a refugia due to brook trout inhabitance and habitat is limited due to the influence of Highway 2. FAR

Wetted Width/Max. Depth Ratio- The average width/depth ratio is not available. A walk through of the stream suggests FAR

Streambank Stability- Stability in 1981 was good but there appears to be numerous slumps along the creek that are visible from the highway. The R-1 Stream Channel Stability Ratings for Skyland Creek completed between 1980 to 1987 were 47 to 98. The R-1 Stream Channel Stability Ratings for the 2nd tributary of Skyland Creek completed between 1980 and 1987 were 56 to 107. The R-1 Stream Channel Stability Ratings for the West Fork of Skyland Creek completed between 1980 and 1987 were 44 to 111. The R-1 Stream Channel Stability Ratings for Bear Creek completed between 1979 and 1981 were 55 to 104. All of these ratings range between a good condition (39-76) and a fair condition (77-114). The lower portions of Bear Creek have extensive areas of unstable streambanks caused by erosion during the 1964 Flood. Stability will decrease in both forks of Skyland Creek due to vegetation loss. FUR

Floodplain Connectivity- The stream does not have access to its floodplain. The stream is very diverse with numerous channel types. FAR

Peak Flow- There are visual indicators of streambank erosion in the Skyland Creek. With the amount of road construction and past harvest activities some increases in peak flow would be expected. Water yield will increase significantly after the fire due to vegetation loss. FUR

Drainage Network- There are areas of roads and skid trails that intercept near surface groundwater during the spring snow melt period. These areas effectively extend the channel network. FAR

Road Density and Location- There are 35 miles of road in Bear Creek with a density of 0.6 mi/mi². The highway infringes on the streams meander pattern. FAR

Disturbance History- High intensity harvest older than 20 years has occurred on 734 acres and 288 acres less than 20 years. Low intensity harvest older than 20 years has occurred on zero acres and 287 acres less than 20 years. FA

Riparian Conservation Areas- The riparian area along Bear Creek and parts of Skyland Creek has been severely compromised due to the highway and road. This has most likely increased water temperatures and has reduced the amount of large woody debris. FAR

Disturbance Regime- There was a 282 acre fire in Giefer Creek in 1987 and an 8,000 acre Challenge Creek fire in 1998 that burned hot throughout both forks of Skyland Creek. FA

Integration of Species and Habitat Conditions- Brook trout are present and the bull trout population is depressed due to changes in Flathead Lake. Habitat in Skyland Creek is good but somewhat limited in Bear Creek. FUR

Granite Creek (1402)

Granite Creek is a 4th order tributary to the Middle Fork. The lower half of the creek is in the wilderness. Bull trout spawn just below the wilderness boundary to below Dodge Creek. Bull trout juveniles are occasionally collected in Challenge Creek but numbers appear to be increasing. No bull trout have been found in Dodge Creek. Granite Creek goes subsurface just downstream of the confluence of Dodge and Challenge creeks which prohibits any spawning further upstream into these two creeks. Most rearing occurs in Granite Creek.

Subpopulation Size- Redd counts are conducted annually and have ranged from a low of 4 in 1996 to a high of 47 in 1984 (see redd count Table above).

??.

Juvenile bull trout populations in ~~Challenge~~ GRANITE Creek.

Year	1981	1982	1983	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Pop. est.	7	1	2	1	8	6	3	2	2	21	1	9	57	9	25

The increase in juveniles in 1995 and 1997 is hard to explain. It's possible that for some reason fish moved up from Granite Creek to rear. No dead fish were observed in Challenge Creek after the fire, however 39 dead cutthroat trout were found in Dodge Creek on September 24, 1998. A population estimate the next week in Dodge Creek was 45 trout/100m which is similar to other population estimates in Dodge Creek.

This subpopulation is functioning at unacceptable risk since its dependent on Flathead Lake bull trout. FUR

Growth and Survival- This subpopulation is most likely in decline and will not improve until measures are taken to alleviate the changes in Flathead Lake. This subpopulation is functioning at unacceptable risk. FUR

Life History Diversity and Isolation- The migratory form is present albeit in depressed numbers. No resident forms are known to exist. Recolonization is unlikely if the migratory form is lost. This subpopulation is functioning at risk. FAR

Persistence and genetic Integrity- No introgression of bull trout has been documented. The potential for hybridization is non-existent given that brook trout are not present in the watershed. Evidence suggests that there is substantial genetic divergence among bull trout populations from different sub-basins in the Flathead (Kanda et al. 1994). The amount of genetic divergence among populations within sub-basins is smaller which suggests that there is some gene flow among subpopulations. Competition/predation is occurring with lake trout in Flathead Lake and all 12 members on a panel of fishery experts responded that there is a greater than 70% probability that this interaction is preventing a recovery goal maintaining 1980's bull trout populations for at least 15 years (McIntyre 1998). Therefore, the probability of this population persisting is low and is functioning at risk. FAR

Temperature- There were 145 incidental temperature measurements associated with water quality monitoring procedures between 1980 to 1995 on Dodge Creek. The maximum water temperature recorded was 13.0° C. There were 149 incidental temperature measurements associated with water quality monitoring procedures between 1980 to 1995 on Challenge Creek. The maximum water temperature recorded was 12.8° C. Challenge Creek and Dodge Creek were 13° C on September 24 in the late afternoon. Temperature may increase in Dodge Creek due to the fire but is doubtful temperatures will increase in Challenge Creek. FA

Sediment- The Flathead National Forest adopted Flathead Basin Commission recommendations for sediment in 1992 through Implementation Note #10. In short, streams that have greater than 35% fines (<6.4mm) are considered threatened while streams with greater than 40% fines are considered impaired. McNeil core samples have been taken in Granite Creek since 1982. Sediment will increase significantly in Dodge Creek but very little in Challenge Creek. It is difficult to determine what the effect will be on Granite Creek, but it is anticipated that levels will increase. FAR

Chemical Contamination/Nutrients- There are no concerns with chemical contamination. Both Granite and Challenge creeks are on the State's 303(d) list of impaired water bodies with aquatic life support (cold water fishery - trout) the probable impaired use. And the probable cause being siltation , or habitat alterations, with the probable source being silviculture practices, and natural sources in Granite Creek. FUR

Habitat Access- There are no man made barriers in this watershed. FA

Embeddedness- The Flathead National Forest does not measure embeddedness. Best professional judgement is that it is FAR.

Large Woody Debris- The 1981 survey indicated that debris was moderate. Most riparian zones are intact. The fire will contribute increasing amounts of LWD in Challenge and Dodge creeks. FA

Pool Frequency- The 1981 survey determined that pool habitat ranged from 4 to 15%. FAR

Large Pools- The 1981 survey used a pool classification system to indicate the value of the pool as fish habitat based upon size, depth and cover. Class I or II pools were zero to 67% in the 1981 survey. Overall, pool quality was poor. FAR

Off Channel Habitats- Off channel habitats are available throughout Granite Creek. FA

Refugia- There is a lot of available habitat in this system that is connected to the Middle Fork and there are no exotic species in the drainage. FA

Wetted Width/Max. Depth Ratio- The average width/depth ratio is not available. Best professional judgement suggests FAR due to the lack of pools and bedload in Dodge Creek.

Streambank Stability- The R-1 Stream Channel Stability Ratings for Granite Creek completed between 1980 were 95 to 102. The R-1 Stream Channel Stability Ratings for Challenge Creek completed between 1980 and 1987 were 62 to 102. The R-1 Stream Channel Stability Ratings for Dodge Creek completed between 1980 to 1987 were 74 to 100. All of these ratings between a good condition (39-76) and a fair condition (77-114). There are several areas in Challenge, Dodge, and Granite Creek where streambanks are unstable and slumping into the creeks. Stability should decrease significantly in Dodge Creek but is not expected to change much in the other streams. FAR

Floodplain Connectivity- The stream has access to its floodplain. FA

Peak Flow- The water yield increase was modeled for the basin in 1991 using the H2OY model. That model predicted a 7.5% annual water yield increase due to the roading and harvest activities. There are visual indicators of bedload movement in several reaches of this stream system. Water yield will increase significantly due to vegetation loss after the fire. FUR

Drainage Network- There are areas of roads and skid trails that intercept near surface groundwater during the spring snow melt period. These areas effectively extend the channel network. FAR

Road Density and Location- There are 20 miles of road in Granite Creek with a density of 0.7. The roads are not in the stream bottom. FA

Disturbance History- High intensity harvest older than 20 years has occurred on 1,124 acres and 181 acres less than 20 years. Low intensity harvest older than 20 years has occurred on 156 acres and 1,803 acres less than 20 years. Upper Granite Creek and Challenge Creek has had a fair amount of harvest on what is considered the most sensitive soils on the Forest. FAR

Riparian Conservation Areas- The riparian area for the most part is intact although there is a lot of blowdown along the stream. FA

Disturbance Regime- The 1998 Challenge Fire burned hot in Dodge Creek throughout 90% of the drainage while only a small portion of Challenge Creek burned. FA

Integration of Species and Habitat Conditions- Granite Creek and its tributaries provide good habitat that is connected but populations are depressed due to changes in Flathead Lake. FAR

Morrison Creek (1403)

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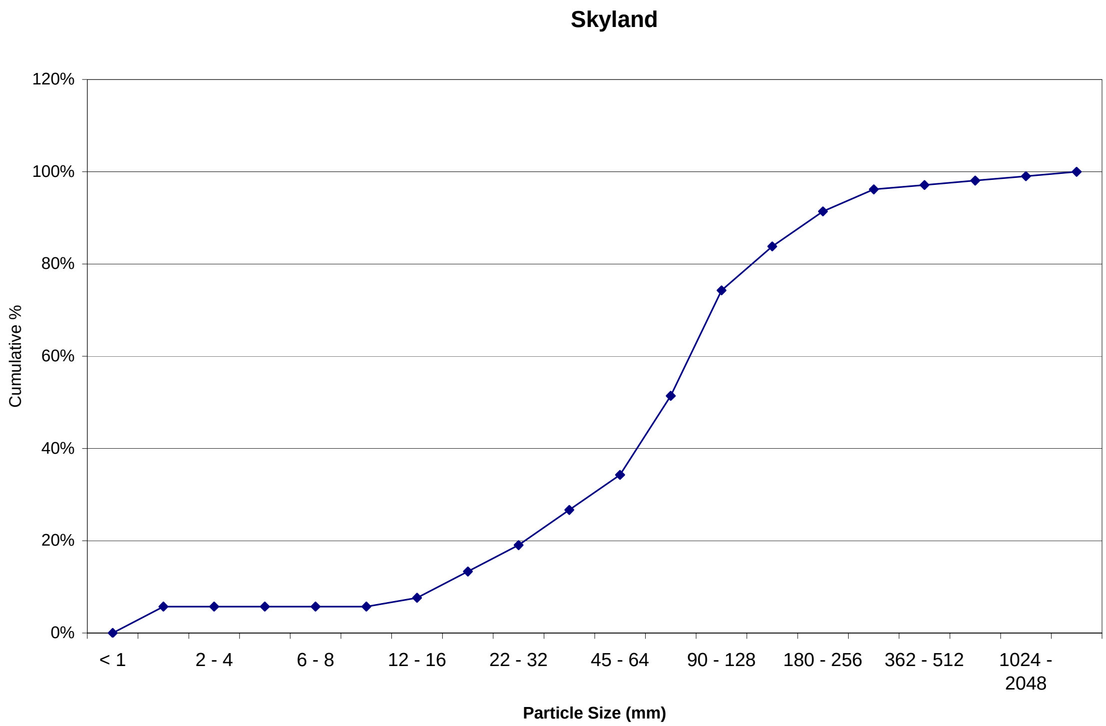
Pebble Counts



SUBSTRATE DEQ/MDM			Skyland		
Particle Category		size (mm)	Count	% of Total	Cum. Total
Silt / Clay		< 1		0.00%	0.00%
Sand		1 - 2	6	5.71%	5.71%
Very Fine	GRAVELS	2 - 4		0.00%	5.71%
Fine	GRAVELS	4 - 6		0.00%	5.71%
Fine	GRAVELS	6 - 8		0.00%	5.71%
Medium	GRAVELS	8 - 12		0.00%	5.71%
Medium	GRAVELS	12 - 16	2	1.90%	7.62%
Coarse	GRAVELS	16 - 22	6	5.71%	13.33%
Coarse	GRAVELS	22 - 32	6	5.71%	19.05%
Very Coarse	GRAVELS	32 - 45	8	7.62%	26.67%
Very Coarse	GRAVELS	45 - 64	8	7.62%	34.29%
Small	COBBLES	64 - 90	18	17.14%	51.43%
Small	COBBLES	90 - 128	24	22.86%	74.29%
Large	COBBLES	128 - 180	10	9.52%	83.81%
Large	COBBLES	180 - 256	8	7.62%	91.43%
Small	BOULDERS	256 - 362	5	4.76%	96.19%
Small	BOULDERS	362 - 512	1	0.95%	97.14%
Medium	BOULDERS	512 - 1024	1	0.95%	98.10%
Large	BOULDERS	1024 - 2048	1	0.95%	99.05%
Bedrock		> 2048	1	0.95%	100.00%
Total # Samples			105		

Skyland Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	0.0 – 1.95 6-Oct.1980	195-2.11 8-Oct.1980	2.11-2.39 8-Oct.1980	2.39-2.59 5-Nov.1980	2.59-2.69 5-Nov.1980	2.69-3.03 5-Nov.1980	3.03-3.83 5-Nov.1980
Landform slope	6	6	8	2	2	2	2
Mass wasting	9	6	6	3	3	3	9
Debris jam potential	6	6	4	8	4	8	4
Vegetat bank protection	9	7	6	3	3	3	3
LOWER BANKS							
Channel capacity	2	2	1	1	1	3	1
Bank rock content	4	4	2	6	4	3	4
Obstructions/flow deflectors/sediment traps	4	4	2	8	2	6	4
Cutting	8	10	8	12	12	8	16
Deposition	10	8	4	12	8	12	8
BOTTOM							
Rock angularity	2	2	2	2	2	12	2
Brightness	3	2	2	2	2	2	1
Consolid or particle pack	4	4	2	4	4	6	4
Bottom size distribution / percent stable materials	8	8	4	12	8	12	8
Scouring and deposition	14	12	8	18	12	18	6
Clinging aquatic vegetat	2	3	2	2	1	2	1
TOTALS	**91**	**84**	**61**	**95**	**68**	**99**	**73**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Skyland Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	3.81-4.26 5Nov.80	Unknown 25July 81	1.95-2.13 10Aug.87	2.13-2.36 10Aug.87	2.36-2.69 10Aug.87	2.69-4.15 10Aug.87	4.15-4.57 10Aug.87	3.89-4.04 30Oct98
Landform slope	2	6	4	8	2	4	6	2
Mass wasting	3	12	7	3	3	8	9	6
Debris jam potential	4	6	4	2	4	6	4	2
Veg. bank protection	3	6	6	12	6	6	7	3
LOWER BANKS								
Channel capacity	2	2	2	1	3	2	2	2
Bank rock content	6	6	4	2	6	6	6	6
Obstructions/f-low deflectors/sed. traps	4	6	4	2	3	6	4	4
Cutting	8	14	10	4	6	9	6	8
Deposition	8	12	10	4	4	12	7	8
BOTTOM								
Rock angularity	2	2	2	2	2	2	2	2
Brightness	2	2	2	2	1	2	1	1
Consol / particle pack	6	4	4	4	4	4	4	4

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	3.81-4.26 5Nov.80	Unknown 25July 81	1.95-2.13 10Aug.87	2.13-2.36 10Aug.87	2.36-2.69 10Aug.87	2.69-4.15 10Aug.87	4.15-4.57 10Aug.87	3.89-4.04 30Oct98
Bottom size distribution / percent stable materials	8	8	8	8	4	8	8	8
Scouring/dep-osition	18	10	12	18	6	12	10	18
Cling aquatic vegetation	2	2	1	1	1	1	2	2
TOTALS	**78**	**98**	**80**	**73**	**55**	**88**	**78**	**76**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

81.1 Average Pfankuch in main Skyland for 1980. One unknown reach in 1981 had **98** Pfankuch rating. **74.8** Average Pfankuch for 1987. One repeated reach in 1998 had **76** rating compared to **78** in 1980 and **88** in 1987.

West Fork Skyland Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	0.0-0.55 9 Oct. 80	0.55-0.88 9 Oct. 80	0.88-1.0 6 Nov.80	1.0-1.15 6 Nov.80	1.15-1.63 6 Nov.80	1.63-2.15 6 Nov.80	0.0-0.86 12 Aug. 87
Landform slope	4	4	6	8	6	6	2
Mass wasting	6	4	3	3	12	9	6
Debris jam potential	4	4	8	6	8	6	2
Vegetat bank protection	7	6	6	9	6	9	3
LOWER BANKS							
Channel capacity	3	2	4	1	1	1	2
Bank rock content	6	6	4	2	4	2	6
Obstructions/flow deflectors/sediment traps	4	3	8	2	6	4	4
Cutting	12	8	8	4	16	8	8
Deposition	10	6	16	8	12	8	8
BOTTOM							
Rock angularity	2	2	2	2	2	2	2
Brightness	3	2	2	2	2	2	2
Consolid or particle pack	4	4	6	2	4	2	4
Bottom size distribution / percent stable materials	8	8	12	4	12	4	8
Scouring and deposition	12	12	18	6	18	6	12
Clinging aquatic vegetat	2	1	2	1	2	1	1
TOTALS	**87**	**72**	**105**	**60**	**111**	**70**	**70**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

West Fork Skyland Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**
	0.86-1.17 12 Aug. 87	1.17-1.58 12 Aug. 87
Landform slope	8	6
Mass wasting	3	9
Debris jam potential	2	4
Vegetative bank protection	6	6
LOWER BANKS		
Channel capacity	1	2
Bank rock content	2	6
Obstructions/flow deflectors/sediment traps	2	3
Cutting	4	8
Deposition	8	8
BOTTOM		
Rock angularity	1	1
Brightness	1	1
Consolidat or particle packing	4	4
Bottom size distribution / percent stable materials	4	8
Scouring and deposition	6	6
Clinging aquatic vegetation	1	1
TOTALS	**53**	**73**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

84.2 Average Pfankuch in West Fork Skyland in 1980. **65.3** Average repeat Pfankuch in 1987.

Morrison Creek

Site Visit Form

Place Site Visit Label Here

03-0927

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-C07
Trip ID: 2003-FLTHD Date: 8/26/03
Personnel: Laidlaw Ardmore

Waterbody Morrison County Flathead HUC 17010207
Station ID C07MORSC01 Visit # ____ Location DStream of Puzzle Creek
Lat 48.21572 Long 113.29020 Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0927M	KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 16:00	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =		µmho/cm
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: 14 min Kick Length (Ft.): 100'

Site Visit Comments:

caught 3 tailed frog tadpoles
good riffle complex
no erosion
sampled downstream of timber harvest

Flathead National Forest Documents

Substrate DEQ/MDM

Stream Name Morrison Creek Station ID Date 7/15/03

Visit Code Personnel C. Lewis K. Wikel

Particle Category		Size Category (mm)	Pebble Count: Dot and Dash Count ⁛ =3, ☒ =10		Sum	% of Total	Cum. Total
Silt/Clay		< 1					
Sand		1-2					
Very Fine	Gravels	2-4					
Fine	Gravels	4-6					
Fine	Gravels	6-8					
Medium	Gravels	8-12					
Medium	Gravels	12-16					
Coarse	Gravels	16-22					
Coarse	Gravels	22-32					
Very Coarse	Gravels	32-45					
Very Coarse	Gravels	45-64					
Small	Cobbles	64-90					
Small	Cobbles	90-128					
Large	Cobbles	128-180					
Large	Cobbles	180-256					
Small	Boulders	256-362					
Small	Boulders	362-512					
Medium	Boulders	512-1024					
Large	Boulders	1024-2048					
Bedrock		>2048					
# of Samples							

FOR INFORMATION

Substrate DEQ/MDM

Stream Name MORRISON Station ID REACH 1 & 2 Date 7-15-03

Visit Code Personnel L. FRIED R. LINDAHL

Particle Category		Size Category (mm)	Pebble Count: Dot and Dash Count ⁚ ‐ =3, ☒ =10 REACH 1	REACH 2	Sum	% of Total	Cum. Total
Silt/Clay		< 1	10	11			
Sand		1-2	2	2			
Very Fine		2-4	2	1			
Fine		4-6	2	1			
Fine		6-8	2	2			7
Medium		8-12	3	4			
Medium		12-16	3	4			
Coarse		16-22	3	6			
Coarse		22-32	7	10			
Very Coarse		32-45	6	9			
Very Coarse	Gravels	45-64	7	10			
Small		64-90	5	12			
Small		90-128	9	4			
Large		128-180	14	11			
Large	Cobbles	180-256	12	7			
Small		256-362	6	7			
Small		362-512	5	2			
Medium		512-1024	5				
Large		1024-2048					
Bedrock	Boulders	>2048					
Total # of Samples							

FOR INFORMATION

Reach # 2 Morrison Ck

FLATHEAD NATIONAL FOREST

STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

Lifred R Lindahl 7-15-03

ITEM RATED	STABILITY INDICATORS BY CLASSES							
UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4 5	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18 21	More than 50% of the bottomin a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS				21				16

Add the values in each column for a total reach score here. (E. 0 + G. 21 +F. 75 +P. 16 = 112)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

75
21
16
112

FOR INFORMATION

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

Reach #1 Morrison Ck L fued R. Lindahl 7-15-03

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
Obstructions/flow deflectors/sediment traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions and deflectors move with high water causing bank cutting and filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
Deposition	Little or no enlargement of channel or point bars.	4	Some new increase in bar formation, mostly from coarse gravels.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
BOTTOM								
Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright..	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
Consolidation or particle packing	Assorted sizes tightly packed and/or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortmnt, easily moved.	8
Bottom size distribution and percent stable materials	No change in sizes evident. Stable materials 80-100%.	4	Distribution shift slight. Stable materials 50-80%.	8	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
Scouring and deposition	Less than 5% of the bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS								

-39
33
72

Add the values in each column for a total reach score here. (E. 0 + G. 22 +F. 72 +P. 12 = 106)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

72
106

INFO... ATION

Morrison Creek
7/15/03

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
Mass wasting (existing or potential)	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or very small. Mostly healed over. Low future potential	6	Moderate frequency & size, with some raw spots eroded by water during high flows.	9	Frequent or large, causing sediment nearly yearlong or imminent danger of same.	12
Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present but mostly small twigs and limbs.	4	Present, volume and size are both increasing.	6	Moderate to heavy amounts, predominantly larger sizes.	8
Vegetative bank protection	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	9	<50% density plus fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS								
Channel capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Overbank flows rare. W/D ratio 8-15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	3	Inadequate. Overbank flows common. W/D ratio >25	4
Bank rock content	65%+ with large, angular boulders 12"+ numerous.	2	40-60%, mostly small boulders to cobbles 6-12".	4	20-40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
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Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
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Rock angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners and edges well rounded in 2 demensions.	3	Well rounded in all demensions, surfaces smooth.	4
Brightness	Surfaces dull, darkened, or stained, generally not bright.	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixed, 50-50% dull and bright,+/- 15% ie. 35-65%.	3	Predominately bright, >65% exposed or scoured surfaces.	4
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COLUMN TOTALS	18							

Add the values in each column for a total reach score here. (E. 18 + G. 36 +F. 6 +P. 0 = 60)

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR INF[illegible]ATION

Morrison Creek
7-15-03

FLATHEAD NATIONAL FOREST
STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

K. Wikel

ITEM RATED	STABILITY INDICATORS BY CLASSES							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform slope	Bank slope gradient <30%	2	Bank slope gradient 30-40%	4	Bank slope gradient 40-60%	6	Bank slope gradient >60%	8
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Clinging aquatic vegetation	Abundant. Growth largely moss-like, dark green, perennial. In swift water too	1	Common. Algal forms in low velocity and pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
COLUMN TOTALS	6		39		21			

Add the values in each column for a total reach score here. (E. 6 + G. 39 +F. 21 +P. 0 = 66)

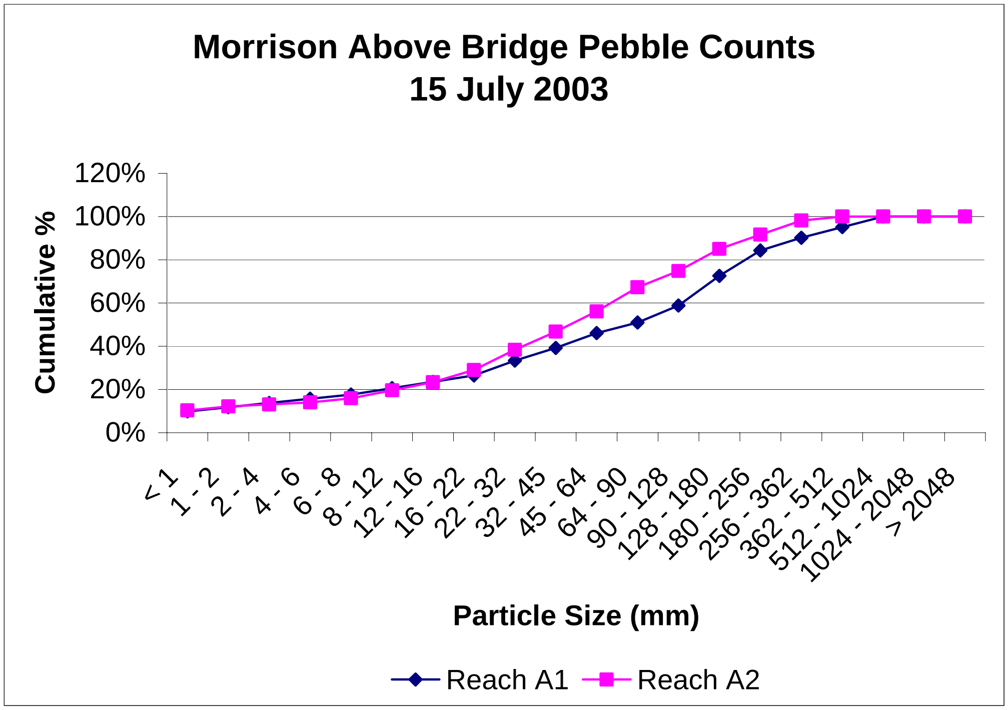
Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, >115=Poor

FOR INFORMATION

Morrison Creek Above Bridge

Pebble Counts

Wolman Pebble counts were also conducted at the Pfankuch reaches at the time of the field visit.



SUBSTRATE DEQ/MDM

Date: 7/15/2003 **Site Visit Code:** Above bridge 1

Waterbody: Morrison Creek **STORET Station ID:**

Personnel: L. Fried, R. Lindahl

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Sum	% of Total	Cum. Total
						Characteristic Group: PEBL-CNT		
				100.00%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	10		10	9.80%	9.80%
2	Sand		1 - 2	2		2	1.96%	11.76%
3	Very Fine	GRAVELS	2 - 4	2		2	1.96%	13.73%
4	Fine	GRAVELS	4 - 6	2		2	1.96%	15.69%
5	Fine	GRAVELS	6 - 8	2		2	1.96%	17.65%
6	Medium	GRAVELS	8 - 12	3		3	2.94%	20.59%
7	Medium	GRAVELS	12 - 16	3		3	2.94%	23.53%
8	Coarse	GRAVELS	16 - 22	3		3	2.94%	26.47%
9	Coarse	GRAVELS	22 - 32	7		7	6.86%	33.33%
10	Very Coarse	GRAVELS	32 - 45	6		6	5.88%	39.22%
11	Very Coarse	GRAVELS	45 - 64	7		7	6.86%	46.08%
12	Small	COBBLES	64 - 90	5		5	4.90%	50.98%
13	Small	COBBLES	90 - 128	8		8	7.84%	58.82%
14	Large	COBBLES	128 - 180	14		14	13.73%	72.55%
15	Large	COBBLES	180 - 256	12		12	11.76%	84.31%
16	Small	BOULDERS	256 - 362	6		6	5.88%	90.20%
17	Small	BOULDERS	362 - 512	5		5	4.90%	95.10%
18	Medium	BOULDERS	512 - 1024	5		5	4.90%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			102	0	102	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/15/2003 **Site Visit Code:** Above bridge 2

Waterbody: Morrison Creek **STORET Station ID:**

Personnel: L. Fried, R. Lindahl

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	11		11	10.28%	10.28%
2	Sand		1 - 2	2		2	1.87%	12.15%
3	Very Fine	GRAVELS	2 - 4	1		1	0.93%	13.08%
4	Fine	GRAVELS	4 - 6	1		1	0.93%	14.02%
5	Fine	GRAVELS	6 - 8	2		2	1.87%	15.89%
6	Medium	GRAVELS	8 - 12	4		4	3.74%	19.63%
7	Medium	GRAVELS	12 - 16	4		4	3.74%	23.36%
8	Coarse	GRAVELS	16 - 22	6		6	5.61%	28.97%
9	Coarse	GRAVELS	22 - 32	10		10	9.35%	38.32%
10	Very Coarse	GRAVELS	32 - 45	9		9	8.41%	46.73%
11	Very Coarse	GRAVELS	45 - 64	10		10	9.35%	56.07%
12	Small	COBBLES	64 - 90	12		12	11.21%	67.29%
13	Small	COBBLES	90 - 128	8		8	7.48%	74.77%
14	Large	COBBLES	128 - 180	11		11	10.28%	85.05%
15	Large	COBBLES	180 - 256	7		7	6.54%	91.59%
16	Small	BOULDERS	256 - 362	7		7	6.54%	98.13%
17	Small	BOULDERS	362 - 512	2		2	1.87%	100.00%
18	Medium	BOULDERS	512 - 1024			0	0.00%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			107	0	107	100.00%	

Morrison Creek Historic Pfankuch Rating Comparison

UPPER BANKS	Stream SegmentI.D. Date	Stream SegmentI.D. Date	Stream SegmentI.D. Date	Steam SegmentI.D. Date	Stream SegmentI.D. Date	Stream SegmentI.D. Date	Stream SegmentI.D. Date
	Morrison 1142 7 Sept.1980	Morrison 1143 7 Sept.1980	Morrison 1144 9 Sept. 1980	Morrison 1145 10 Sept. 80	Morrison 1146 12 Sept. 80	Morrison 1147 12 Sept. 80	Morrison 1148 13 Sept.81
Landform slope	8	6	6	4	2	2	6
Mass wasting	9	9	9	9	9	6	6
Debris jam potential	6	7	8	6	5	6	8
Vegetat bank protection	6	6	9	9	9	8	9
LOWER BANKS							
Channel capacity	2	2	2	2	2	2	2
Bank rock content	7	8	8	6	6	6	6
Obstructions/flow deflectors/sediment traps	4	4	6	6	3	7	6
Cutting	10	8	12	12	10	12	8
Deposition	8	8	8	8	8	12	10
BOTTOM							
Rock angularity	2	2	2	2	2	2	2
Brightness	3	2	2	2	3	3	1
Consolidat particle pack	5	6	4	2	5	3	5
Bottom size distribution/ percent stable materials	10	12	8	8	6	10	10
Scouring and deposition	10	10	18	12	15	15	12
Clinging aquatic vegetat	3	3	3	3	3	2	2
TOTALS	**93**	**93**	**105**	**91**	**88**	**94**	**93**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

94 Average Pfankuch for September 1980 ratings. **93** Single Pfankuch rating for 1981.

The next table compares the major tributaries of Morrison. Puzzle Creek is the drainage where historic timber management (clearcuts) occurred and Lodgepole is the tributary entirely within wilderness designation.

Puzzle and Lodgepole Historic Pfankuch Rating Comparison.

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	Lodgepole 1155 22 Aug.1980	Lodgepole 1156 20 Aug.1980	Lodgepole 1157 12 Sept.1981	Puzzle 1124 7 Oct. 1980	Puzzle 1126 7 Oct. 1980	Puzzle 1127 7 Oct. 1980	Puzzle 956 7 Oct. 1980
Landform slope	2	4	2	2	2	4	4
Mass wasting	8	9	7	3	6	6	11
Debris jam potential	8	8	6	2	6	4	8
Vegetat bank protection	5	10	6	3	5	3	9
LOWER BANKS							
Channel capacity	2	2	2	2	2	2	3
Bank rock content	7	5	6	2	4	2	6
Obstructions/flow deflectors/sediment traps	4	6	6	4	4	2	6
Cutting	8	10	10	4	6	8	12
Deposition	8	8	12	8	12	8	14
BOTTOM							
Rock angularity	2	3	2	2	2	1	2
Brightness	2	2	2	1	1	2	2
Consolidat/ particle packing	4	5	6	2	2	2	5
Bottom size distribution/ percent stable materials	12	10	12	8	8	4	12
Scouring and deposition	18	12	9	6	12	12	15
Clinging aquatic vegeta	2	3	2	2	2	1	4
TOTALS	**92**	**97**	**90**	**51**	**74**	**61**	**113**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

94.5 Average Pfankuch rating for Lodgepole in August 1980 and **90** rating for one reach in September 1981.

Puzzle Historic Pfankuch Rating Comparison continued with 2003 Morrison results.

UPPER BANKS	**Stream Segment I.D Date**	**Stream SegmentI.D Date**	**Stream Segment I.D Date**	**Stream Segment I.D Date**	**Stream Segment I.D Date**	**Stream Segment Date**	**Str.segment Date**
	Puzzle 958 7 Oct. 1980	Puzzle 959 7 Oct. 1980	Puzzle 960 7 Oct. 1980	Morrison Above #1 15 July 2003	Morrison Above #2 15 July 2003	Morrison Below #1 15 July 2003	Morrison Below #2 15 July 2003
Landform slope	2	2	2	6	6	2	4
Mass wasting	3	9	6	9	9	9	3
Debris jam potential	2	6	6	4	4	4	6
Vegetat bank protection	3	9	5	12	12	6	6
LOWER BANKS							
Channel capacity	2	3	2	3	2	2	2
Bank rock content	3	5	4	4	5	4	2
Obstructions/flow deflectors/sediment traps	3	5	4	4	6	2	4
Cutting	4	12	8	12	12	12	4
Deposition	8	12	12	8	8	8	8
BOTTOM							
Rock angularity	2	2	2	2	2	2	4
Brightness	1	3	1	3	4	2	1
Consolidat/ particle pack	2	5	2	6	6	2	2
Bottom size distribution/ percent stable materials	8	12	8	12	12	8	2
Scouring and deposition	6	12	12	18	21	12	8
Clinging aquatic vegetat	2	2	2	3	3	2	2
TOTALS	**51**	**99**	**76**	**106**	**112**	**66**	**60**

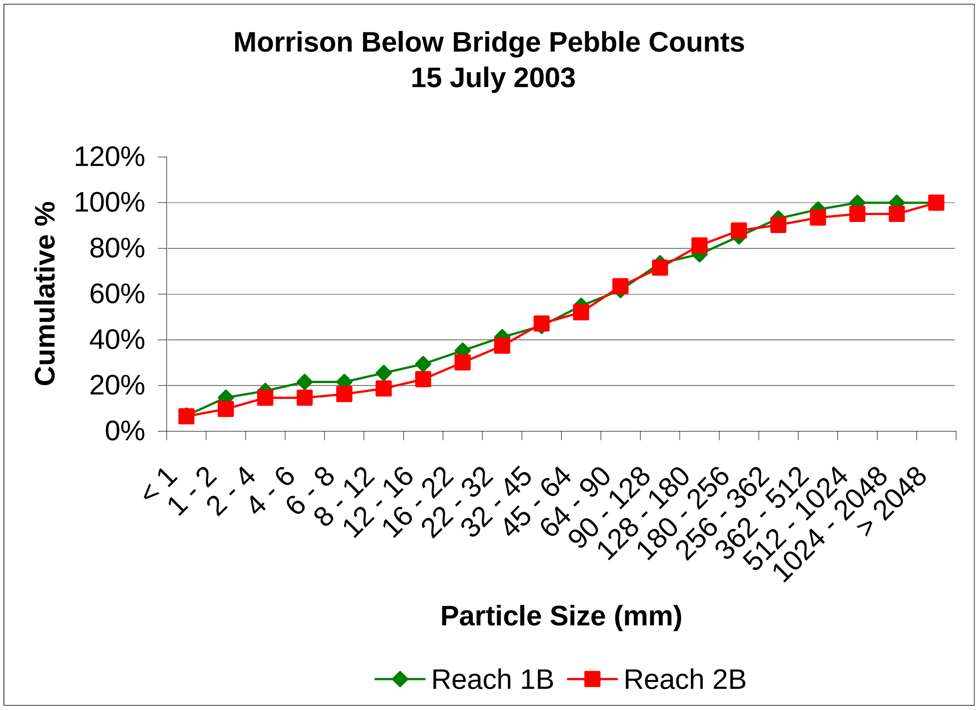
Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

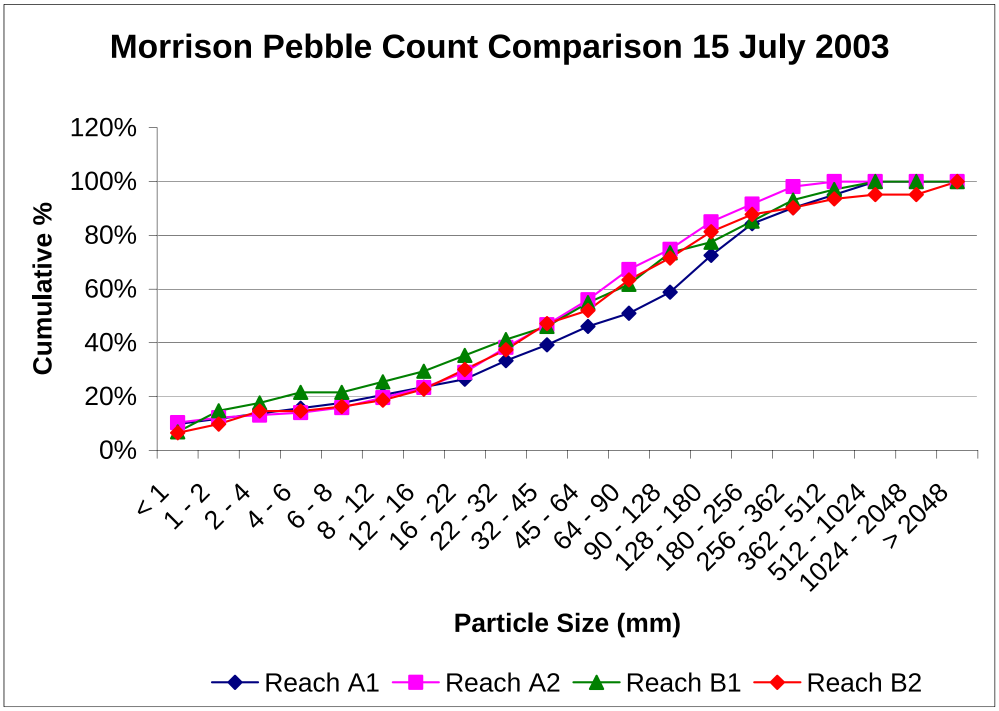
75 Average for 7 reaches in Puzzle Cr. in October 1980.

“Above” in Morrison refers to bridge on Morrison Creek just below confluence with Puzzle Creek. Two Pfankuch surveys on reaches were completed above the bridge and two were completed “Below” the bridge. The results of Fair (average **109)** above the bridge and Good (average **63)** below the bridge were as expected by the senior hydrologist (Dean Sirucek) at the Three Forks Zone

Morrison Creek Below Bridge

Pebble Counts





SUBSTRATE DEQ/MDM

Date: 7/15/2003 **Site Visit Code:** Below Bridge 1

Waterbody: Morrison Creek **STORET Station ID:**

Personnel: C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	7		7	6.86%	6.86%
2	Sand		1 - 2	8		8	7.84%	14.71%
3	Very Fine	GRAVELS	2 - 4	3		3	2.94%	17.65%
4	Fine	GRAVELS	4 - 6	4		4	3.92%	21.57%
5	Fine	GRAVELS	6 - 8			0	0.00%	21.57%
6	Medium	GRAVELS	8 - 12	4		4	3.92%	25.49%
7	Medium	GRAVELS	12 - 16	4		4	3.92%	29.41%
8	Coarse	GRAVELS	16 - 22	6		6	5.88%	35.29%
9	Coarse	GRAVELS	22 - 32	6		6	5.88%	41.18%
10	Very Coarse	GRAVELS	32 - 45	5		5	4.90%	46.08%
11	Very Coarse	GRAVELS	45 - 64	9		9	8.82%	54.90%
12	Small	COBBLES	64 - 90	7		7	6.86%	61.76%
13	Small	COBBLES	90 - 128	12		12	11.76%	73.53%
14	Large	COBBLES	128 - 180	4		4	3.92%	77.45%
15	Large	COBBLES	180 - 256	8		8	7.84%	85.29%
16	Small	BOULDERS	256 - 362	8		8	7.84%	93.14%
17	Small	BOULDERS	362 - 512	4		4	3.92%	97.06%
18	Medium	BOULDERS	512 - 1024	3		3	2.94%	100.00%
19	Large	BOULDERS	1024 - 2048			0	0.00%	100.00%
20	Bedrock	BOULDERS	> 2048			0	0.00%	100.00%
21	Total # Samples			102	0	102	100.00%	

SUBSTRATE DEQ/MDM

Date: 7/15/2003 **Site Visit Code:** Below Bridge 2

Waterbody: Morrison Creek **STORET Station ID:**

Personnel: C. Lewis, K. Wikel

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
				100%	0.00%	Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	8		8	6.50%	6.50%
2	Sand		1 - 2	4		4	3.25%	9.76%
3	Very Fine	GRAVELS	2 - 4	6		6	4.88%	14.63%
4	Fine	GRAVELS	4 - 6			0	0.00%	14.63%
5	Fine	GRAVELS	6 - 8	2		2	1.63%	16.26%
6	Medium	GRAVELS	8 - 12	3		3	2.44%	18.70%
7	Medium	GRAVELS	12 - 16	5		5	4.07%	22.76%
8	Coarse	GRAVELS	16 - 22	9		9	7.32%	30.08%
9	Coarse	GRAVELS	22 - 32	9		9	7.32%	37.40%
10	Very Coarse	GRAVELS	32 - 45	12		12	9.76%	47.15%
11	Very Coarse	GRAVELS	45 - 64	6		6	4.88%	52.03%
12	Small	COBBLES	64 - 90	14		14	11.38%	63.41%
13	Small	COBBLES	90 - 128	10		10	8.13%	71.54%
14	Large	COBBLES	128 - 180	12		12	9.76%	81.30%
15	Large	COBBLES	180 - 256	8		8	6.50%	87.80%
16	Small	BOULDERS	256 - 362	3		3	2.44%	90.24%
17	Small	BOULDERS	362 - 512	4		4	3.25%	93.50%
18	Medium	BOULDERS	512 - 1024	2		2	1.63%	95.12%
19	Large	BOULDERS	1024 - 2048			0	0.00%	95.12%
20	Bedrock	BOULDERS	> 2048	6		6	4.88%	100.00%
21	Total # Samples			123	0	123	100.00%	

Sullivan Creek

Sullivan Creek above Connor Creek Confluence

Site Visit Forms

Attach Label Here
02-C200

completed and verified 7-15-02 pit

Field Sampling Data
(One Station per page)

Trip ID ______ Date 8/22/02
Leader/Staff: Tina Laidlaw/Rosie Sada

Waterbody Name: Sullivan Creek County ______ HUC ______
Station ID: SULLCØ1 Visit #: 01 Location: sullivan creek above confluence with Conner Creek
Lat: 47.97563 Long: 113.66874 Verified? ☒ By ______ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☒ N ☐ If Y what method used? If by map what is the map scale? ______

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☒ Commons ☒	02-C200 8/22/02 /1220	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	02-C200	KICK HESS OTHER:
Algae/Macrophytes	☒	DEQ Aquatic Plant Form ☐	02-C200	PERI-1 OTHER:
Chlorophyll a	☒		02-C200	CHLPHL-2 OTHER:
Habitat Assessment	☐	NRCS ☒ DEQ ☒ PFC ☐ EMAP ☐		Purpose:
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☒	Rosgen		DEQ Camera
Photographs	☒	1 upstream /downstream	1st roll pictures 1 = upstream	#1 upstream
Field Notes	☒	in blue riverfield book	2 = downstream	#2 downstream
Other				

Measurements:	Time: 1230
Q / Flow (cfs)	10.52 Est. ☐
Temp: (°C)	W 10.79 / A 34
pH:	7.89
SC: (µmho/cm)	104 us/cm
~~EC: (µmho/cm)~~	
DO: (mg/L)	9.32 mg/L
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	

Comments:
altitude @ 4092 ft via GPS 19:16 22 UTC
weather = clear + sunny ~ 70-75° F
dry / high cirrus clouds

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 8/22/02 Site Visit Code: 02-C200

Waterbody: Sullivan Creek Site:

Personnel: Laidlaw / Schroeder / Tyler

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 10	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 8	9-10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 20	16-20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 20	16-20	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 14	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 7		
	Right Side 6	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 7		
	Right Side 6	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 8		
	Right Side 8	Comments:		

TOTAL SCORE: 114

Score compared to maximum possible: 130

87.69%

STREAM CLASSIFICATION SHEET

Date: 8/22/02 Site Visit Code: 02-C200

Waterbody Sullivan Creek Site:

Personnel: Laidlaw / Schroeder / Tyler

Elevation:	Rosgen Classification:
Ecoregion*:	Drainage Basin:
Stream Order:	Gradient**:
Depth:	Aspect:
Upstream Length****:	Riparian Shading:
Road density:	Drainage Density***:
Primary Source of Water:	Photograph #'s:

*Ecoregion should be determined by use of an Omernik ecoregion map.
**Gradient should be determined for the entire reach being assessed and is measured in feet per mile.
***Drainage density is measured in miles per acre upstream from site being assessed.
****Upstream length is a measure from the site to the FURTHEST point upstream.
For many of the above fields, it will be necessary to get the information from maps or other like sources.

Determine percent land use in the watershed:
Contact Conservation Districts for information on land use.

Dryland agriculture	
Irrigation	
Urban	
Grazing	
Feedlots	
Mining-surface	
Mining-subsurface	
Timber harvest	
Other (explain):	

See back of sheet

Percent land use should be determined for the entire watershed of the stream reach being assessed.

POSSIBLE SOURCES OF IMPAIRMENT

In the space following each specific land use, please comment on possible sources of impairment.

LAND USE	
Dryland crop	NA
Irrigated crop	NA
Grazing	NA
Feedlots	NA
Mining-surface	NA
Mining-subsurface	NA
Timber Harvest	-timber harvest began early to mid 1960's -management + road building.
Urban	NA
Roads	- timber harvest - logging roads reclaimed as use (recreation, wildlife) changes
Natural	- steep sided ridges + narrow valleys in glaciated mountainous terrain. -high gradient, high discharge streams high energy
:her (explain):	

21.1.1.4

STREAM REACH ASSESSMENT FORM

Date: 8/22/02 Site Visit Code: 02-C2

Waterbody: Sullivan Creek Site:

Personnel: Patti Tyler, William Schreeder, Tina Laidlaw / Donna Pridmore

PHOTO/SLIDE #'S: John Dixon, Julio Porras, Dean Sirucek

ANSWER ALL: N/R=UNABLE TO RECORD N/A=NOT APPLICABLE
TYPE "X" IN BOX NEXT TO DESCRIPTION THAT BEST FITS EACH CATEGORY

(1) Predominant vegetation & landscape characteristics in the watershed beyond the immediate riparian zone:

- Perennial vegetation, flat to rolling landscape [ ]
- Perennial vegetation, rolling to steep landscape [X]
- Mixed perennial vegetation & annual crops, flat to rolling landscape [ ]
- Cropland, rolling to steep landscape [ ]

Comments: Subalpine fir from regeneration
Lodgepole pine, western larch
cottonwood, willow, serviceberry, red osier dogwood / alders

(2) Meanders:

- Slight meandering--relatively straight channel with only occasional curves. [ ]
- Travel length is basically the same as the straight line distance [ ]
- Moderate meandering--easy, gradual bends in the channel path [X]
- Extreme meandering--travel length of flow is greater than twice the straight line distance [ ]

Comments:

(3) Flood flow width:

- Floods are confined in narrow canyon with width less than twice that of channel [X]
- Floods confined to a flow width of 2-3 times the width of the channel [ ]
- Floods are unconfined and spill out onto flat valley bottom [ ]

Comments:

(4) Gradient

- Steep - Continuous rapids [ ]
- Moderate - Alternating rapids, riffles and smooth surfaced reaches [X]
- Gradual - Smooth surfaced reaches with occasional riffles [ ]
- Flat - Very rare disruptions in smooth flat surface of stream [ ]

Comments:

1.Average width of riparian zone

(> 90 ft wide)	16-20
Varies from 15 to 90 ft	14 11-15
15 ft)	6-10
parian zone absent	1-5

Comments (e.g. potential):

2.Completeness of vegetation in the riparian zone
(Any vegetation functioning to maintain the bank)

Riparian zone intact without breaks in vegetation	19 16-20
Breaks occurring intermittently.	11-15
Breaks frequent with some gullies and scars every 100 - 150 ft	6-10
Deeply scarred with active headcutting and gully formation all along reach	1-5
Is there evidence of sediment from the upper watershed or riparian area reaching the stream channel?	(Y)es or (N)o

If yes, please describe:

Comments: for this reach sampled

3. Characteristics of the Riparian vegetation

Diversity of perennial plant species reflects potential for site; Dense growth; good plant vigor and age diversity	16-20
proximately 60% of mature plant species present; plant vigor stable, density of growth mostly open sy to walk through)	15 11-15
tle diversity in perennial plant species, and/or age of trees; plants scattered; vigor poor	6-10
Site is dominated by annual forbs and weeds; few perennial or climax plants present	1-5

Comments: second & third generation regrowth - fire caused snags & larch remnants

4. Width/Depth ratio. The point where high flow normally reaches on the bank & is most easily determined on straight channel sections where the "scoured" channel meets the "permanent" vegetation. Look for characteristics such as terracing, soil changes (rock to soil), presence/absence of vegetation or debris

Width/depth ratio <8	10-12
Width/depth ratio 8 to 15	7-9
Width/depth ratio 15 to 25	5 4-6
Width/depth ratio > 25 or stream is channelized or channel is an incised gully	1-3

N/A

Comments:

5.Channel stability/bar formation

Little or no channel instability resulting from sediment accumulation	10-12
Some gravel bars of coarse stones and well-washed debris present, little silt	9 7-9
Point bars enlarging by gravel, sand and/or silt, new bars forming	4-6
hannel divided into braids or stream is channelized	1-3

Comments:

6.Bank erosion

Little or none evident, banks appear stable and are held firmly by vegetation	16-20
Erosion occurring on some outside bends and channel constrictions; non-eroding banks stable	15 11-15
Erosion common on most outside bends and channel constrictions	6-10
Erosion predominant on entire channel (straight sections, inside and outside bends, etc.)	1-5

Comments:

(Answer ONE, either 7a. OR 7b.)

7a. Stream bottom - (For Fast moving/Riffle dominated streams)

Stony bottom of several sizes packed together, interstices obvious	20 16-20
Stony bottom easily moved, with little silt	11-15
Bottom of silt, gravel and sand, stable in places	6-10
Uniform bottom of sand and silt loosely held together, stony substrate absent	1-5

7b. Stream bottom - (For Slow moving/Pool dominated streams)

Mixture of substrate materials with gravel and firm sand prevalent; vascular root mats and submerged vegetation common	16-20
Mixture of soft sand, mud or clay; mud may be dominant; some vascular root mats and submerged vegetation present	11-15
All mud or clay, or channelized with sand bottom; little or no submerged vegetation	6-10
Hardpan clay or bedrock; no vascular root mat or submerged vegetation	1-5

Comments:

8a. Riffle/pool spacing - (For Fast moving/Riffle dominated streams)

Distinct, occurring at intervals of 5-7x stream width	20 16-20
Irregularly spaced, 8-15x stream width	11-15
Long pools separating short riffles, meanders absent, 16-25x stream width	6-10
Meanders and riffles/pools absent or stream channelized, >25x stream width	1-5

8b. Riffle/pool characteristics - (For Slow moving/Pool dominated streams)

Even mix of deep, shallow, large and small pools	16-20
Majority of pools large and deep, very few shallow pools	11-15
Shallow pools more prevalent than deep pools	6-10
Majority of pools small and shallow or pools absent	1-5

Comments:

9.Aquatic plant growth

Not apparent, but rocks or other submerged objects feel slippery	12 10-12
In small patches or along channel edges	7-9
In large patches or discontinuous mats	4-6
Mats cover bottom (hyper-enriched conditions) or plants not apparent and rocks not slippery (stream devoid of algae because of toxic conditions)	1-3

Comments:

10.Turbidity

Clear	12 10-12
Slightly off color	7-9
Opaquem (can see through)	4-6
Cloudy (can't see through)	1-3

Color:

Is rain or runoff influencing turbidity levels today? N (Y)es or (N)o

Comments:

.Water surface oils

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

(Place "X" next to all that apply)

Slick:

Sheen:

Flecks:

(Please describe):

Comments:

12. Materials other than sediment on channel bottom (e.g. iron or aluminum oxides, calcium carbonate)

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

State color:

Comments:

13. Salinization

None evident	12	10-12
Evidence of salinity is present in the watershed, but no salt crusts observed in or near the stream		7-9
Minor evidence of salts in or near the stream. Plant diversity may be reduced or dominated by salt tolerant species		4-6
Salt crusts common in or near the stream or on stream banks. Vegetation may be severely reduced due to salt		1-3

Comments:

14. Water odor

None	12	10-12
Slight		7-9
Moderate		4-6
Strong		1-3

Describe odor:

Sewage:

Petroleum:

Chemical:

Natural:

Other:

Comments:

15.

No apparent loss (irrigation return flow may be supplementing base flow)	12 10-12
Water loss noticeable, however flows are adequate to support aquatic organisms	7-9
Flow supports aquatic organisms, but habitat, especially riffles, is drastically reduced	4-6
Channel may be dry or flow low enough to preclude or severely impair aquatic organisms	1-3

Are irrigation diversion or return structures present? (Y)es or (N)

Comments:

16. *Amount of fish cover (Relative % of reach with some type of fish cover)*

Extensive (> 50%)	10-12
Moderate (25-50%)	9 7-9
Sparse (< 25%)	4-6
Absent or "choking" vegetation only	1-3

Fish cover types--(P) present, (C) common, (A) abundant, (N) none

Undercut banks: A
anging vegetation: C
Deep pools: C
ɔgs/Woody Debris: P
Boulders: A
Rootwads: P
ıquatic Vegetation: N
Other:

Additional Comments:

TOTAL MAXIMUM COMPARED TO MAXIMUM POSSIBLE:

%TOTAL:

205 Max = 228

87-100%=Non-impaired; Fully supporting
80-86%=Non-impaired; Fully supporting, but threatened
71-79%=Minor impairment; Partially supporting
55-70%=Moderate impairment; Partially supporting
0-54%=Severe impairment; Non-supporting

90%

TOTAL MAXIMUM COMPARED TO REFERENCE STREAM:

Total Value: Note: Data should be compared to reference condition.

this stream is a possible reference site

Reference Stream Value:

Enter value of reference stream in order to compare results from stream being assessed.

> 75%=Fully supporting
50-75%=Partially supporting
< 50%=Non-supporting

21.1.1.9

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Date: 9/22/02 Site Visit Code: 02-C200

Waterbody Sullivan Creek Site:

Personnel: Tyler/Laidlaw/Schneider

Place an "X" next to all that apply. Add additional observations in space provided for comments.

RIPARIAN ZONE/INSTREAM FEATURES

X	Forest
	Field/Pasture
	Agricultural
	Residential
	Commercial
	Roads
	Industrial
	Other (Describe):

Comments:

Local Watershed Erosion:

	None
	Little
X	Moderate
	Heavy

Comments: – natural steep slopes – avalanche shoots – ~~mass~~ road building associated w/ timber management

Local Watershed NPS Pollution:

	No evidence
X	Some potential sources – see above
	Obvious sources

Comments:

	Current estimated stream width (m)
	Estimated stream width at bankfull (m)

Estimated stream depth:

	Riffle (m)
	Run (m)
	Pool (m)

	Estimated stream width at flood plain (m)
	Velocity (ft/s)
N	Is there a dam present? (Y)es or (N)o
Y	Is the stream channelized? (Y)es or (N)o

Comments:

Canopy Cover:

	Open
X	Partly open
	Partly shaded
	Shaded

Comments:

DIMENT/SUBSTRATE

Sediment odors:

	Normal
	Sewage
	Petroleum
	Chemical
	Anaerobic
X	None
	Other (Describe):

Comments:

Sediment oils:

X	Absent
	Slight
	Moderate
	Profuse

Comments:

Sediment deposits:

	Sludge
	Sawdust
	Paper fiber
X	Sand
	Relic shells
	Other (Describe):

Comments:

N	Are the undersides of stones which are not deeply embedded black? (Y)es or (N)o

ORGANIC SUBSTRATE COMPONENTS

Substrate Type	Characteristic	% comp. in sampling area
Detritus	Sticks, wood, course	<5%
Muck-Mud	Black, very fine organic	0%

Comments:

WATER QUALITY

Stream Type

X	Cold water
	Cool water
	Warm water

Explain answer:

Water odors

	Normal
	Sewage
	Petroleum
	Chemical
X	None
	Other (Describe):

Comments:

Water surface oils

	Slick
	Sheen
	Globs
	Flecks
X	None

Comments:

TOTAL DISCHARGE:

Date: 8/22/02 Site Visit Code: 02-C200

Waterbody Sullivan Creek Site:

Personnel: Laidlaw/Schroeder/Tyler

Time = 13:05

**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
18	0.15	0.21	1		0.0315
17	0.15	0.04	1		0.006
16	0.25	0.18	1		0.045
15	0.55	0.82	1		0.451
14	0.6	1.00	1		0.6
13	0.6	1.03	1		0.618
12	0.75	0.99	1		0.7425
11	0.9	0.95	1		0.855
10	0.95	1.13	1		1.0735
9	1.1	1.27	1		1.397
8	1.05	1.30	1		1.365
7	0.8	1.38	1		1.104
6	0.9	1.04	1		0.936
5	0.3	0.72	1		0.216
4	0.30	0.54	1		0.162
3	0.9	0.46	1		0.414
2	0.8	0.46	1		0.368
1	0.7	0.19	1		0.133
0	0	0	1		0
					10.52 cfs

NOTE: 19 Feet Wide

First blank is used to mark the bank.
Begin measurements from the left bank (determine left bank while looking downstream).
Initial point is often the tape reading of the waterline & has no depth or velocity to measure.
If this is the case, the first measurement is made at the first point where there is adequate depth (at least 0.2 ft) and measurable velocity.

The value for the "Distance from initial point" field is not necessarily the tape reading. Make sure it is reflective of the true distance from the bank.

If there is a sharp drop in water level near the bank, you must compensate for the discharge that is occurring near the bank. To do so, you must insert a "dummy" value in the first "distance" blank. This value should be equal to the second value (i.e. the first measurement).

At points where there is stagnant water or backflow effects, begin and end measurements at the edge of where positive flow can be measured.

Read depths on wading rod ignoring the "pile-up" effect of water on the rod.

Velocity is measured at six-tenths depth from the water surface by moving the probe support so that the foot indicator marks 25 to 30 cross-sections are adequate to reduce the level of error.

Sections should be spaced so none contain more than 10% of the flow. Ideal measurements have less than 5% in a section.

AQUATIC PLANT FIELD SHEET

Date: 8/22/02 Site Visit Code: 02-C200

Waterbody Sullivan Creek Site:

Personnel: Tyler / Laidlaw / Schroeder

Purpose: The purpose of completing this form is to estimate the percent of wetted substrates at the sampling site covered by each of the major categories of aquatic plants, to record the relative amount of accumulated growth in each category, and to note the general color and condition of plants in each category. This information will help to describe the health and productivity of the aquatic ecosystem, define nuisance aquatic plant problems, identify potential sources and causes of pollution, and document changes in the plant community over time.

Type of plant growth	Cover (%)	Amount of growth	Color	Condition
Microalgae	5	L	blue green + diatoms	- growing
Macroalgae	15	M	light brown	filaments - growing
Mosses	0			
Macrophytes	0			
Bare substrate	80	H	green, purple red	growing
Total	100 %			

Substrates present (please rank):

rock: 1

wood: 3

sediment: sand 2

other (list):

1)

2)

3)

4)

5)

Explanation and Definitions

Cover: Estimate the percent of wetted substrate area colonized by each of the plant categories listed, and the percent area that is not colonized by any plants (see **Bare Substrate**, overleaf). Also, rank the types of substrates that are available for colonization by plants (1 = substrate accounting for the most area, etc.).

Amount: Record the relative amount of plant growth in each category as being **light**, **moderate**, or **heavy**. Light growth barely covers the substrate surface and is not immediately evident. Heavy growth extends almost to the water surface or beyond. Moderate growth is intermediate between light growth and heavy growth.

Color: The colors of aquatic plants are clues to their identity and to the health of aquatic ecosystems. Plant colors may span the spectrum of hues in the rainbow (see **Microalgae** below). Record the predominant color of the plants in each of the categories present.

Condition: Aquatic plants go through seasonal cycles of growth, maturity, and decay. The condition of a plant or group of plants will indicate the stage of this seasonal cycle. Growing plants show new growth and bright colors. Mature plants are larger but have more subdued colors because of age, epiphytes and sediment deposits. Decaying plants display a loss of both pigmentation and physical integrity. Enter **growing**, **mature**, or **decaying**.

Microalgae: Microalgae are microscopic algae appearing as pigmented accumulations attached to or resting upon submerged surfaces. This category commonly includes diatom "slimes" and films of green, blue-green, or euglenoid algae in depositional areas. Colors may range through shades of yellow, red, brown, green, blue and black. Included here are accumulations of "sewage fungus" (tan-gray) below sources of organic pollution, "yellow boy" (yellow-orange) below mine adits, and iron bacteria (orange-brown) in groundwater seeps and springs.

Macroalgae: Macroalgae are macroscopic algae whose individual plants or colonies are visible to the aided eye. Macroalgae may be free-floating, or they may be attached to or resting upon submerged surfaces. Examples of macroalgae include filamentous growth forms (*Cladophora, Spirogyra, Ulothrix*), plant-like algae with leaf-like structures (*Chara, Nitella*), compact round or flattened colonies (*Nostoc, Rivularia*), gelatinous masses (*Chaetophora, Tetraspora*), and short, tubular strands (*Lemanea*). Color is highly variable, as it is with the microalgae.

Moss: Mosses are primitive plants that are intermediate in complexity between algae and higher plants. Mosses are common in cold-water habitats in western Montana. Mosses are typically green in color; the shade of green varies with plant vigor and the amount of sediment accumulation.

Macrophytes: Macrophytes or "higher plants" are distinguished from algae and mosses by their larger size and by the presence of true leaves, roots and flowers. Rooted macrophytes typically colonize areas of sediment deposition. Macrophytes may be free-floating (duckweed), submergent (pondweed), or emergent (cattails, bulrush, water lily).

Bare Substrate: Substrates may be void of plant growth because of toxic or sterile conditions or because of recently scoured or unstable substrates. Rocks in mountain lakes and streams may appear to be barren at first glance, but closer examination often reveals a very thin film of diatoms (microalgae) that feels slippery or slimy to the touch. Similarly, nearshore sediment deposits that have not been disturbed for several days will usually develop a film of microalgae. Examine these substrates closely.

21.1.1.5

STREAM DISCHARGE MEASUREMENT NOTES

Date: 8/22/02 Site Visit Code: 02-C200

Waterbody Sullivan Creek Site:

Personnel: Laidlow/ Schroeder / Tyler

Width:	19'
Area:	
Velocity:	
Gage height:	
Meter type:	Marsh - McBirney
Meter #:	
No. of sections:	18 (20 if include banks)
Flow:	10.52

Sample method (wading, cable, through ice, boat, upstream or downstream side of bridge):

Marsh McBirney

Distance from gage (ft. or miles); above or below gage?

N/A

Measurement rated excellent (2%), good (5%), fair (8%), or poor (> 8%) based on following conditions:

good; 4 exceedances of EPA's 10% rule

Comments:

FIELD GUIDE FOR STREAM CLASSIFICATION

Stream Channel Classification (Level II) ....

Stream NAME: Sullivan (02-C200)

Basin NAME: Flathead HUD Drainage AREA: ______ Ac. ______ SqMi.

Location: Off West Side Rd Hungry Horse Res

Twp: ______ Rge: ______ Sec: ______ Qtr: ______ Lat. ______ Long. ______

Observers: WS/TL/DT Date: 8/22/02

Bankfull WIDTH (W_{bkf}) 30.55' Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 2.31 Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf} = A / W_{bkf}$)

Bnkfl. X-Section AREA (A_{bkf}) 70.57 Sq.Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width / Depth RATIO (W_{bkf} / d_{bkf}) 13.2
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 3.4 Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 48.25 Ft.
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) 1.58
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 54.5 mm. Very coarse gravel
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) .02 Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

from map Channel SINUOSITY (K) 2.5/2 = 1.25 from aerial photo
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type B4 For reference, note: Stream Type Chart & Classification Key

TABLE 2. Level II classification criteria, (field form)

21

Substrate DEQ/MDM

Stream Name Sullivan Creek Station ID Date 8/22/02

Site Visit Code 02-C200 Personnel Laidlaw/Schroeder/Tyler

Particle Category		Size Category (mm)	Dot and Dash Count ⁘ = 3, ⊠ = 10	Sum	% of Total	Cum. Total
Silt/Clay		< 1		4	4%	
Sand		1-2		3	3	
Very Fine	Gravels	2-4		5	5%	
Fine	Gravels	4-6		3	3%	
Fine	Gravels	6-8		3	3%	
Medium	Gravels	8-12		4	4%	
Medium	Gravels	12-16		4	4%	
Coarse	Gravels	16-22		7	7%	
Coarse	Gravels	22-32		3	3%	
Very Coarse	Gravels	32-45		6	6%	
Very Coarse	Gravels	45-64		7	7%	
Small	Cobbles	64-90		14	15%	
Small	Cobbles	90-128		9	9.5%	
Large	Cobbles	128-180		19	20%	
Large	Cobbles	180-256		12	12.6	
Small	Boulders	256-362		19	20%	
Small	Boulders	362-512		8	8	
Medium	Boulders	512-1024				
Large	Boulders	1024-2048				
Bedrock	Boulders	>2048		7	7%	
Total # of Samples				95		

95/2 = 47.5

Very coarse gravel D50 54.5

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

Montana
12/2000

RIPARIAN ASSESSMENT WORKSHEET

Name of Stream: Sullivan Creek Station ID 02-C200
ID Team/Observers: Laidlaw/Schroeder/Tyler Date: 8/22/
Length of Reach: ______ Other Data ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 5 Potential Score: 6

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 5 Potential Score: 6

Comments

1

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 4 Potential Score: 6

Comments

estion 6, Weeds :

= No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments Napweed – from hay at horsecamp.

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

nments

2

Question 8, Woody Species Establishment and Regeneration: (Note. Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 7 Potential Score: 8

Comments – missing media age trees – second growth ≈ 60 yr. with regen ≈ 10-15 yr. ∴ no 20 yr age class.

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 2 Potential Score: 4

Comments elk – moose – mule deer

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating >_ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating >_ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating >_ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating >_ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating >_ 6

Actual Score: ______ Potential Score: ______

do later

Comments N/A because it's a high gradient Mountain stream
but if need to it would be an 8 since dominated by Subalpine Fir + red osier dogwood

3

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the m

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

STREAM/PROJECT: ______ REACH I.D ______ DATE: ______

	A / P		Actual Score	Possible Points	Potential Score
QUESTION 1:	8/8	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	5/6	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	5/6	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	3/3	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	4/4	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	2/3	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	3/3	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	7/8	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	2/4	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	N/A	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	6/6	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
12	6/6				
13	6/6				
14	6/6				
		Total	0	61	0

	Actual Score	Possible Points	Potential Score
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)	0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)	0	(49)	0

A = 45

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0! = 91.8 = 92%

P = 49

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

Sustainable

* Only in certain, specific situations can both of these receive an "N/A".

#15 6/6 #18 8/8
#16 4/4 #19 6/8
#17 3/3

4

Montana Department of Environmental Quality
Supplemental Questions to NRCS Riparian Assessment Worksheet

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, and/or aquatic vegetation

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream type would not support a fishery under natural conditions

Actual Score: 6 Potential Score: 6

Comments - fish habitat for spawning species

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 6 Potential Score: 6

Comments

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

5

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments protozoa - Giardia

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 3 Potential Score: 3

Comments empty stone fly cases, midge larvae observed. Indy fly larva. helgramite cases.

6

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 6 Potential Score: 8

Comments

Total Actual 45 Total Potential 47

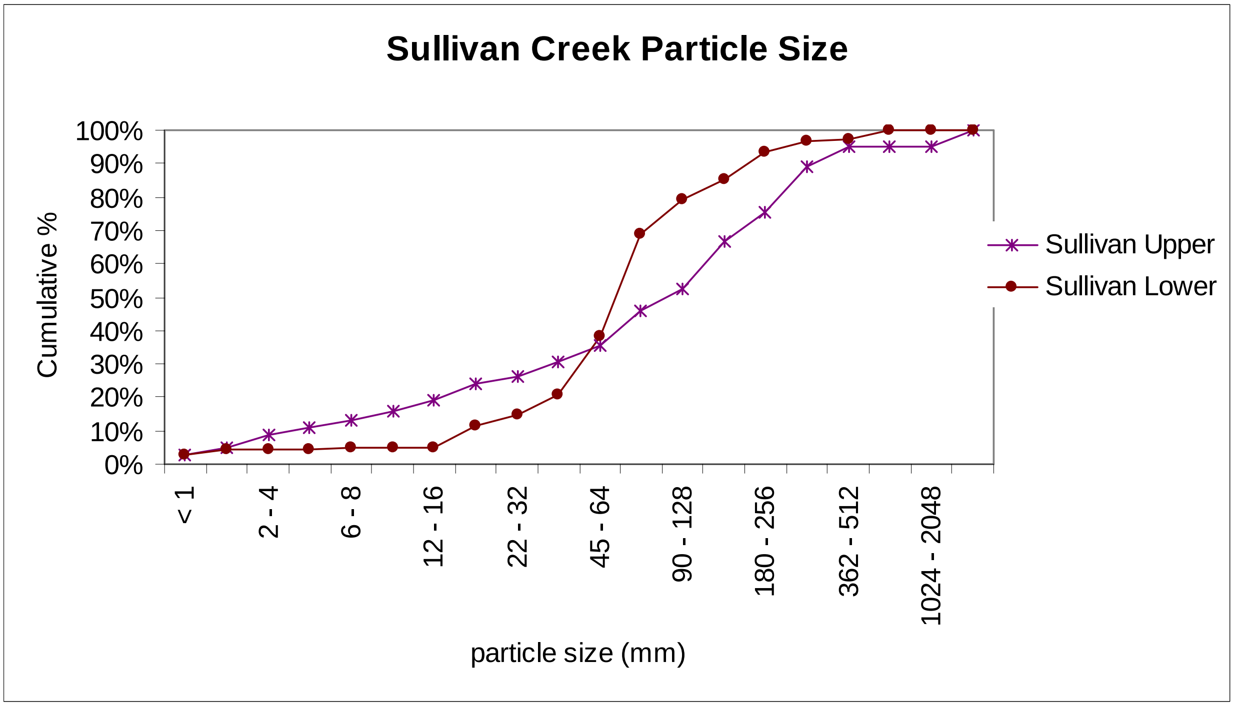
RATING $\frac{\text{Total}}{\text{Potential}}$ x 100 #DIV/0! 96%

OVERALL RATING $\frac{\text{(Total NRCS Actual + Total MT Supplement Actual)}}{\text{(Total NRCS Potential + Total MT Supplement Potential)}}$ x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

7. Updated 4/2002

Pebble Counts



SUBSTRATE DEQ/MDM				Sullivan Upper	
			Count	% of Total	Cum. Total
Silt / Clay		< 1	4	2.92%	2.92%
Sand		1 - 2	3	2.19%	5.11%
Very Fine	GRAVELS	2 - 4	5	3.65%	8.76%
Fine		4 - 6	3	2.19%	10.95%
Fine		6 - 8	3	2.19%	13.14%
Medium		8 - 12	4	2.92%	16.06%
Medium		12 - 16	4	2.92%	18.98%
Coarse		16 - 22	7	5.11%	24.09%
Coarse		22 - 32	3	2.19%	26.28%
Very Coarse		32 - 45	6	4.38%	30.66%
Very Coarse		45 - 64	7	5.11%	35.77%
Small	COBBLES	64 - 90	14	10.22%	45.99%
Small		90 - 128	9	6.57%	52.55%
Large		128 - 180	19	13.87%	66.42%
Large		180 - 256	12	8.76%	75.18%
Small	BOULDERS	256 - 362	19	13.87%	89.05%
Small		362 - 512	8	5.84%	94.89%
Medium		512 - 1024		0.00%	94.89%
Large		1024 - 2048		0.00%	94.89%
Bedrock		> 2048	7	5.11%	100.00%
Total # Samples			137		

Sullivan Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	1.963-1.964 23 Aug. 74	3.855-3.856 23 Aug. 74	4.688-4.689 23 Aug. 74	6.877-6.878 23 Aug. 74	9.848-9.849 23 Aug. 74	
Landform slope	6	6	8	2	8	
Mass wasting	3	3	6	6	12	
Debris jam potential	4	4	4	2	2	
Vegetative bank protection	3	3	6	3	9	
LOWER BANKS						
Channel capacity	2	2	2	2	2	
Bank rock content	2	6	2	2	4	
Obstructions/flow deflectors/sediment traps	2	4	2	4	2	
Cutting	12	12	4	8	16	
Deposition	12	12	4	8	12	
BOTTOM						
Rock angularity	2	2	3	2	2	
Brightness	2	2	1	2	1	
Consolidat or particle pack	2	6	6	2	2	
Bottom size distribution / percent stable materials	8	12	12	8	4	
Scouring and deposition	12	18	18	12	12	
Clinging aquatic vegetation	3	3	4	3	3	
TOTALS	**75**	**95**	**82**	**66**	**91**	

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Sullivan Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	3.653-3.961 28 July 87	3.961-6.903 3 Aug. 87	6.903-9.694 4 Aug. 87	9.694-10.249 4 Aug. 87	Upper Bridge 22 Aug. 2002	Below Quin. 22 Aug. 2002
Landform slope	2	2	4	4	4	2
Mass wasting	12	12	9	9	6	12
Debris jam potential	5	5	4	4	4	6
Vegetative bank protection	9	9	6	9	6	9
LOWER BANKS						
Channel capacity	4	4	2	2	2	3
Bank rock content	4	4	4	4	2	2
Obstructions/flow deflectors/sediment traps	6	6	6	4	2	4
Cutting	14	14	12	8	8	12
Deposition	14	14	14	12	4	12
BOTTOM						
Rock angularity	4	4	4	2	2	2
Brightness	4	4	4	2	4	4
Consolidat or particle pack	8	8	6	4	4	4
Bottom size distribution / percent stable materials	12	12	12	12	4	16
Scouring and deposition	24	24	18	16	12	24
Clinging aquatic vegetation	4	4	4	2	3	3
TOTALS	**126**	**126**	**109**	**94**	**63**	**115**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

81.8 Average Sullivan Cr. Pfankuch for 1974.
113.0 Average Sullivan Cr. Pfankuch for 1987.

Sullivan Creek Tributaries Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Slide Creek 0.003-0.1 23 Aug. 1974	Slide Creek 0.349-0.35 23 Aug. 1974	Connor Cr. 0.0-0.1 22 Aug. 1974	Connor Cr. 0.983-0.984 22 Aug. 1974	Connor Cr. 0.0-0.849 28 July 1987
Landform slope	6	6	2	8	4
Mass wasting	10	6	3	9	7
Debris jam potential	8	4	2	6	6
Vegetative bank protection	3	3	3	3	6
LOWER BANKS					
Channel capacity	1	1	2	1	2
Bank rock content	2	2	2	2	4
Obstructions/flow deflectors/sediment traps	6	4	4	4	4
Cutting	12	12	8	12	8
Deposition	8	8	8	8	12
BOTTOM					
Rock angularity	2	3	2	2	3
Brightness	1	3	1	3	3
Consolidat or particle pack	2	4	2	2	6
Bottom size distribution / percent stable materials	8	8	8	8	10
Scouring and deposition	12	12	12	18	12
Clinging aquatic vegetation	3	3	3	3	3
TOTALS	**84**	**79**	**62**	**89**	**90**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Sullivan Creek Tributaries Historic Pfankuch Rating Comparison

UPPER BANKS	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**	**Stream segment Date**
	Branch Cr. 1.711-1.721 22 Aug.1974	Branch Cr. 0.0-0.458 28 July 1987	Ball Cr. 0.0-0.1 21 Aug. 1974	Ball Cr. 1.023-1.024 21 Aug. 1974	Ball Cr. 0.0-0.849 28 July 1987
Landform slope	4	5	6	8	6
Mass wasting	6	6	6	6	6
Debris jam potential	4	4	6	6	5
Vegetative bank protection	3	6	3	3	6
LOWER BANKS					
Channel capacity	2	2	2	2	2
Bank rock content	4	5	2	2	4
Obstructions/flow deflectors/sediment traps	4	4	4	4	6
Cutting	12	10	8	12	9
Deposition	8	12	8	8	8
BOTTOM					
Rock angularity	2	2	3	2	2
Brightness	2	3	2	3	4
Consolidat or particle pack	2	6	4	4	5
Bottom size distribution / percent stable materials	8	8	8	8	12
Scouring and deposition	12	18	18	18	18
Clinging aquatic vegetation	3	3	4	3	3
TOTALS	**76**	**94**	**84**	**89**	**96**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Sullivan Creek Below Quintonkian

Site Visit Forms

Field Sampling Data

(One Station per page)

Attach Label Here

02-C201

STORET Project ID ______

Trip ID ______ Date 8/22/02

Leader/Staff: Laidlaw / Sada

Waterbody Name Sullivan Creek - below Quintonkian County ______ HUC ______

Station ID 48 1' 62" Visit # 01 Location Sullivan Creek below Quintonkian

Lat 48.02782 Long 113.70524 Verified? ☒ By ______ GPS Datum (Circle One): NAD 27 NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☒ N ☐ If Y what method used? If by map what is the map scale? ______

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☑ Metals ☑ Commons ☑	02-C201	GRAB
Sediment	☐	n/a		SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	02-C201	KICK HESS OTHER:
Algae/Macrophytes	☒	DEQ Aquatic Plant Form ☐	02-C201	PERI-1 OTHER:
Chlorophyll a	☒		02-C201	CHLPHL-2 OTHER:
Habitat Assessment	☒	NRCS ☒ DEQ ☒ PFC ☐ EMAP ☐		Purpose:
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☒			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 16:30	
Q / Flow (cfs)	46.2	Est. ☐
Temp: (°C)	W 14.09	A 33.0
pH:	8.14 SU	
SC: (μmho/cm)	173 us/cm	
~~EC: (μmho/cm)~~		
DO: (mg/L)	8.93 Mg/L	

TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐

Turbidity Comments:

Comments:

Water Samples Collected At 16:35
altitude = 3623 ft by GPS

FIELD GUIDE FOR STREAM CLASSIFICATION

Stream Channel Classification (Level II) .....

Stream NAME: Sullivan Creek (02-C201)

Basin NAME: ______ Drainage AREA: ______ Ac. ______ SqMi.

Location: ______

Twp: ______ Rge: ______ Sec: ______ Qtr: ______ Lat. ______ Long. ______

Observers: Laidlaw / Schroeder / Tyler Date: 8/22/02

Bankfull WIDTH (W_{bkf}) 104 Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 2.11 Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf} = A / W_{bkf}$)

Bnkfl. X-Section AREA (A_{bkf}) 219.44 Sq.Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width / Depth RATIO (W_{bkf} / d_{bkf}) 49.29
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 3.09 Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 219 Ft.
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) 2.10
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 77 mm. small cobble
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 1.42 Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) Map 1.2
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/ VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type C3 — For reference, note: Stream Type Chart & Classification Key

ER rates as a B - I think it was a C

TABLE 2. Level II classificaton criteria, (field form)

Down - Up = 6.97

Instrument Height = 5.74
Downstream Height = 12.77
Upstream Height = 5.8

Total Length = 490
slope = 6.97/490 = 1.42%

21

Substrate DEQ/MDM

Stream Name Sullivan Creek Station ID Date 8/22/02

Site Visit Code 02-C201 Personnel Laidlaw/Schroeder/Tyler

Pebble Count							
Particle Category		Size Category (mm)	Dot and Dash Count ⁚. =3, ☒ =10	Sum	% of Total	Cum. Total
Silt/Clay		< 1		3	2.5	
Sand		1-2		2	1.65%	
Very Fine	Gravels	2-4				
Fine	Gravels	4-6				
Fine	Gravels	6-8		1	.83%	
Medium	Gravels	8-12				
Medium	Gravels	12-16				
Coarse	Gravels	16-22		8	6.6%	
Coarse	Gravels	22-32		4	3.3%	
Very Coarse	Gravels	32-45		7	5.8%	
Very Coarse	Gravels	45-64		21	17.4	
Small	Cobbles	64-90		37	30.6	
Small	Cobbles	90-128		13	10.7%	
Large	Cobbles	128-180		7	5.8%	
Large	Cobbles	180-256		10	8.3%	
Small	Boulders	256-362		4	3.3%	
Small	Boulders	362-512		1	1.65%	
Medium	Boulders	512-1024		3	2.5%	
Large	Boulders	1024-2048				
Bedrock	Boulders	>2048				
Total # of Samples				121		

D50 - small cobble - 64-90

Median ~~cobble~~ 77 MM

Percent Fines

Date: Site Visit Code:

Waterbody: Site:

Personnel:

Station	Count
1	
2	
3	
4	
5	
6	

* Left flood plain is 70´ beyond 00

* Right Flood plain is 45´ from Right Edge of Stream

IH = 5.74

Left edge of bank: Elev: 4.20

.70	11´	=	5.04
.30	17´	=	5.44
1.05	23´	=	6.79
.93	30´	=	6.67
1.77	35´	=	7.51
1.52	40´	=	7.26
1.54	45´	=	7.28
1.83	50´	=	7.57
2.4	55´	=	8.14
2.25	60´	=	7.99
2.85	65´	=	8.59
2.82	70´	=	8.56
2.95	75´		8.69

Left * Edge of Water 54´ = 7.76

80´	=	8.66	2.[illegible]
85´	=	8.38	2.64
90´	=	8.83	3.09
95´	=	8.53	2.79
100´	=	8.21	2.47
105´	=	8.18	2.44
110´	=	8.02	2.28
115´	=	8.44	2.7

118´

Right edge of water = 7.77

Right edge of bank = 5.24

120´

Avg Depth 2.1´

21.1.1.5

STREAM DISCHARGE MEASUREMENT NOTES

Date: 8/22/02 Site Visit Code: 02-C201

Waterbody Sullivan Creek d/s Quintana Site:

Personnel: Laidlaw / Schneider / Tyler

Width:	33 Ft
Area:	
Velocity:	
Gage height:	
Meter type:	Marsh McBirney
Meter #:	?
No. of sections:	22
Flow:	46.2 cfs

Sample method (wading, cable, through ice, boat, upstream or downstream side of bridge):

Flow Meter

Distance from gage (ft. or miles); above or below gage?

N/A

Measurement rated excellent (2%), good (5%), fair (8%), or poor (> 8%) based on following conditions:

Excellent: no violations of 10% Rule WCS

Comments:

TOTAL DISCHARGE:

Date: 8/22/12 Site Visit Code: 02-C201

Waterbody: Sullivan Creek Site:

Personnel: Laidlaw / Schroeder / Tyler

**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1.5	0.3	1.46	2.25	.675	.99
3.0	0.45	1.00	1.5	.675	.68
4.5	0.35	1.68	1.5	.525	.88
6.0	0.25	1.09	1.5	.375	.41
7.5	0.55	2.34	1.5	.825	1.93
9.0	0.65	2.46	1.5	.975	2.40
10.5	0.90	1.04	1.5	1.35	1.40
12.0	1.05	0.89	1.5	1.58	1.41
13.5	1.0	2.94	1.5	1.5	3.78
15.0	1.2	2.52	1.5	1.8	4.536
16.5	1.1	2.75	1.5	1.65	4.5375
18.0	1.25	2.19	1.5	1.88	4.10625
19.5	0.80	2.04	1.5	1.20	2.448
21.0	0.75	2.71	1.5	1.125	3.04875
22.5	1.0	2.48	1.5	1.5	3.72
24.0	1.4	2.18	1.5	2.1	4.578
25.5	1.1	0.87	1.5	1.65	1.4355
27.0	1.1	1.23	1.5	1.65	2.0295
28.5	0.8	1.22	1.5	1.20	1.464
30.0	0.9	0.03	1.5	1.35	0.405
31.5	0.2	0.08	2.25	0.45	0.036
33.0	0	0	—	—	—

NOTE:
First blank is used to mark the bank.
Begin measurements from the left bank (determine left bank while looking downstream).
Initial point is often the tape reading of the waterline & has no depth or velocity to measure.
If this is the case, the first measurement is made at the first point where there is adequate depth (at least 0.2 ft) and measurable velocity.

The value for the "Distance from initial point" field is not necessarily the tape reading. Make sure it is reflective of the true distance from the bank.

If there is a sharp drop in water level near the bank, you must compensate for the discharge that is occurring near the bank. To do so, you must insert a "dummy" value in the first "distance" blank. This value should be equal to the second value (i.e. the first measurement).

At points where there is stagnant water or backflow effects, begin and end measurements at the edge of where positive flow can be measured.
Read depths on wading rod ignoring the "pile-up" effect of water on the rod.
Velocity is measured at six-tenths depth from the water surface by moving the probe support so that the foot indicator marks
25 to 30 cross-sections are adequate to reduce the level of error.

Sections should be spaced so none contain more than 10% of the flow. Ideal measurements have less than 5% in a section.

Flow = 46.2 cfs

STREAM CLASSIFICATION SHEET

Date: 8/22/02 Site Visit Code: 02-C201

Waterbody: Sullivan Creek Site:

Personnel: Laidlaw /Schroeder / Tyler

Elevation:	Rosgen Classification:
Ecoregion*:	Drainage Basin:
Stream Order:	Gradient**:
Depth:	Aspect:
Upstream Length****:	Riparian Shading:
Road density:	Drainage Density***:
Primary Source of Water:	Photograph #'s:

*Ecoregion should be determined by use of an Omernik ecoregion map.
**Gradient should be determined for the entire reach being assessed and is measured in feet per mile.
***Drainage density is measured in miles per acre upstream from site being assessed.
****Upstream length is a measure from the site to the FURTHEST point upstream.
For many of the above fields, it will be necessary to get the information from maps or other like sources.

Determine percent land use in the watershed:
Contact Conservation Districts for information on land use.

Dryland agriculture	
Irrigation	
Urban	
Grazing	
Feedlots	
Mining-surface	
Mining-subsurface	
Timber harvest	
Other (explain):	

Percent land use should be determined for the entire watershed of the stream reach being assessed.

POSSIBLE SOURCES OF IMPAIRMENT

In the space following each specific land use, please comment on possible sources of impairment.

LAND USE	
Dryland crop	N/A
Irrigated crop	N/A
Grazing	N/A
Feedlots	N/A
Mining-surface	N/A
Mining-subsurface	N/A
Timber Harvest	clearcutting + harvesting upstream
Urban	N/A
Roads	FS Roads + harvest roads
Natural	no fires
Other (explain):	

21.1.1.9

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Date: 8/22/02 Site Visit Code: 02-C201

Waterbody Sullivan Creek Site: below Quintonkia

Personnel: Laidlaw / Schroeder / Tyler

Place an "X" next to all that apply. Add additional observations in space provided for comments.

RIPARIAN ZONE/INSTREAM FEATURES

X	Forest
	Field/Pasture
	Agricultural
	Residential
	Commercial
	Roads
	Industrial
	Other (Describe):

Comments:

Local Watershed Erosion:

	None
	Little
X	Moderate
	Heavy

Comments:

Local Watershed NPS Pollution:

	No evidence
X	Some potential sources
	Obvious sources

Comments:

	Current estimated stream width (m)
	Estimated stream width at bankfull (m)

Estimated stream depth:

	Riffle (m)
	Run (m)
	Pool (m)

	Estimated stream width at flood plain (m)
	Velocity (ft/s)
N	Is there a dam present? (Y)es or (N)o
N	Is the stream channelized? (Y)es or (N)o

Comments:

Canopy Cover:

	Open
X	Partly open
	Partly shaded
	Shaded

Comments:

DIMENT/SUBSTRATE

Sediment odors:

X	Normal
	Sewage
	Petroleum
	Chemical
	Anaerobic
	None
	Other (Describe):

Comments:

Sediment oils:

X	Absent
	Slight
	Moderate
	Profuse

Comments:

Sediment deposits:

	Sludge
	Sawdust
	Paper fiber
X	Sand
	Relic shells
	Other (Describe):

Comments:

N	Are the undersides of stones which are not deeply embedded black? (Y)es or (N)o

ORGANIC SUBSTRATE COMPONENTS

Substrate Type	Characteristic	% comp. in sampling area
Detritus	Sticks, wood, course	< 5%
Muck-Mud	Black, very fine organic	0%

Comments:

WATER QUALITY

Stream Type

X	Cold water
	Cool water
	Warm water

Explain answer:

Water odors

	Normal
	Sewage
	Petroleum
	Chemical
X	None
	Other (Describe):

Comments:

Water surface oils

	Slick
	Sheen
	Globs
	Flecks
X	None

Comments:

21.1.1.4

STREAM REACH ASSESSMENT FORM

Date: 8/22/02 Site Visit Code: 02-Ci

Waterbody: Sullivan Creek-below Site:

Personnel: Laidlaw/Schneider/Tyler

PHOTO/SLIDE #'S:

ANSWER ALL: N/R=UNABLE TO RECORD N/A=NOT APPLICABLE
TYPE "X" IN BOX NEXT TO DESCRIPTION THAT BEST FITS EACH CATEGORY

(1) Predominant vegetation & landscape characteristics in the watershed beyond the immediate riparian zone:

Perennial vegetation, flat to rolling landscape	
Perennial vegetation, rolling to steep landscape	X
Mixed perennial vegetation & annual crops, flat to rolling landscape	
Cropland, rolling to steep landscape	

Comments:

(2) Meanders:

Slight meandering--relatively straight channel with only occasional curves.	
Travel length is basically the same as the straight line distance	
Moderate meandering--easy, gradual bends in the channel path	X
Extreme meandering--travel length of flow is greater than twice the straight line distance	

Comments:

(3) Flood flow width:

Floods are confined in narrow canyon with width less than twice that of channel	
Floods confined to a flow width of 2-3 times the width of the channel	X
Floods are unconfined and spill out onto flat valley bottom	

Comments:

(4) Gradient

Steep - Continuous rapids	
Moderate - Alternating rapids, riffles and smooth surfaced reaches	X
Gradual - Smooth surfaced reaches with occasional riffles	
Flat - Very rare disruptions in smooth flat surface of stream	

Comments:

1.Average width of riparian zone

(> 90 ft wide)	19 16-20
Varies from 15 to 90 ft	11-15
?-15 ft)	6-10
.parian zone absent	1-5

Comments (e.g. potential): ____________________

2.Completeness of vegetation in the riparian zone
(Any vegetation functioning to maintain the bank)

Riparian zone intact without breaks in vegetation	16-20
Breaks occurring intermittently.	11 11-15
Breaks frequent with some gullies and scars every 100 - 150 ft	6-10
Deeply scarred with active headcutting and gully formation all along reach	1-5
Is there evidence of sediment from the upper watershed or riparian area reaching the stream channel?	(Y)es or (N)o

If yes, please describe:

Comments: ____________________

3. Characteristics of the Riparian vegetation

Diversity of perennial plant species reflects potential for site; Dense growth; good plant vigor and age diversity	17 16-20
^pproximately 60% of mature plant species present; plant vigor stable, density of growth mostly open sy to walk through)	11-15
.tle diversity in perennial plant species, and/or age of trees; plants scattered; vigor poor	6-10
Site is dominated by annual forbs and weeds; few perennial or climax plants present	1-5

Comments: ____________________

4. Width/Depth ratio. The point where high flow normally reaches on the bank & is most easily determined on straight channel sections where the "scoured" channel meets the "permanent" vegetation. Look for characteristics such as terracing, soil changes (rock to soil), presence/absence of vegetation or debris

Width/depth ratio <8	10-12
Width/depth ratio 8 to 15	7-9
Width/depth ratio 15 to 25	4-6
Width/depth ratio > 25 or stream is channelized or channel is an incised gully	1-3

Comments: ____________________

5.Channel stability/bar formation

Little or no channel instability resulting from sediment accumulation	10 10-12
Some gravel bars of coarse stones and well-washed debris present, little silt	7-9
Point bars enlarging by gravel, sand and/or silt, new bars forming	4-6
Channel divided into braids or stream is channelized	1-3

Comments: ____________________

6.Bank erosion

Little or none evident, banks appear stable and are held firmly by vegetation		16-20
Erosion occurring on some outside bends and channel constrictions; non-eroding banks stable		11-15
Erosion common on most outside bends and channel constrictions	9	6-10
Erosion predominant on entire channel (straight sections, inside and outside bends, etc.)		1-5

Comments:

(Answer ONE, either 7a. OR 7b.)

7a. Stream bottom - (For Fast moving/Riffle dominated streams)

Stony bottom of several sizes packed together, interstices obvious	20	16-20
Stony bottom easily moved, with little silt		11-15
Bottom of silt, gravel and sand, stable in places		6-10
Uniform bottom of sand and silt loosely held together, stony substrate absent		1-5

7b. Stream bottom - (For Slow moving/Pool dominated streams)

Mixture of substrate materials with gravel and firm sand prevalent; vascular root mats and submerged vegetation common		16-20
Mixture of soft sand, mud or clay; mud may be dominant; some vascular root mats and submerged vegetation present		11-15
All mud or clay, or channelized with sand bottom; little or no submerged vegetation		6-10
Hardpan clay or bedrock; no vascular root mat or submerged vegetation		1-5

Comments:

8a. Riffle/pool spacing - (For Fast moving/Riffle dominated streams)

Distinct, occurring at intervals of 5-7x stream width	19	16-20
Irregularly spaced, 8-15x stream width		11-15
Long pools separating short riffles, meanders absent, 16-25x stream width		6-10
Meanders and riffles/pools absent or stream channelized, >25x stream width		1-5

8b. Riffle/pool characteristics - (For Slow moving/Pool dominated streams)

Even mix of deep, shallow, large and small pools		16-20
Majority of pools large and deep, very few shallow pools		11-15
Shallow pools more prevalent than deep pools		6-10
Majority of pools small and shallow or pools absent		1-5

Comments:

9.Aquatic plant growth

Not apparent, but rocks or other submerged objects feel slippery	12	10-12
In small patches or along channel edges		7-9
In large patches or discontinuous mats		4-6
Mats cover bottom (hyper-enriched conditions) or plants not apparent and rocks not slippery (stream devoid of algae because of toxic conditions)		1-3

Comments:

10.Turbidity

Clear	12	10-12
Slightly off color		7-9
Opaquem (can see through)		4-6
Cloudy (can't see through)		1-3

Color:

Is rain or runoff influencing turbidity levels today? N (Y)es or (N)o

Comments:

.Water surface oils

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

(Place "X" next to all that apply)

Slick:

Sheen:

Flecks:

(Please describe):

Comments:

12. Materials other than sediment on channel bottom (e.g. iron or aluminum oxides, calcium carbonate)

None	12	10-12
Slight		7-9
Moderate		4-6
Severe		1-3

State color:

Comments:

13. Salinization

None evident	12	10-12
Evidence of salinity is present in the watershed, but no salt crusts observed in or near the stream		7-9
Minor evidence of salts in or near the stream. Plant diversity may be reduced or dominated by salt tolerant species		4-6
Salt crusts common in or near the stream or on stream banks. Vegetation may be severely reduced due to salt		1-3

Comments:

14. Water odor

None	12	10-12
Slight		7-9
Moderate		4-6
Strong		1-3

Describe odor:

Sewage:

Petroleum:

Chemical:

Natural:

Other:

Comments:

No apparent loss (irrigation return flow may be supplementing base flow)	12 10-12
Water loss noticeable, however flows are adequate to support aquatic organisms	7-9
Flow supports aquatic organisms, but habitat, especially riffles, is drastically reduced	4-6
Channel may be dry or flow low enough to preclude or severely impair aquatic organisms	1-3

Are irrigation diversion or return structures present? N (Y)es or (

Comments:

16. Amount of fish cover (Relative % of reach with some type of fish cover)

Extensive (> 50%)	10-12
Moderate (25-50%)	8 7-9
Sparse (< 25%)	4-6
Absent or "choking" vegetation only	1-3

Fish cover types--(P) present, (C) common, (A) abundant, (N) none

Undercut banks: P
anging vegetation: C
Deep pools: C
ogs/Woody Debris: C
Boulders: A
Rootwads: C
quatic Vegetation: P
Other:

Additional Comments:

TOTAL MAXIMUM COMPARED TO MAXIMUM POSSIBLE:

%TOTAL:
197

Max - 228

86%

87-100%=Non-impaired; Fully supporting
80-86%=Non-impaired; Fully supporting, but threatened
71-79%=Minor impairment; Partially supporting
55-70%=Moderate impairment; Partially supporting
0-54%=Severe impairment; Non-supporting

TOTAL MAXIMUM COMPARED TO REFERENCE STREAM:

Total Value: Note: Data should be compared to reference condition.

this is a possible reference site

Reference Stream Value:

Enter value of reference stream in order to compare results from stream being assessed.

> 75%=Fully supporting
50-75%=Partially supporting
< 50%=Non-supporting

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

Montana
12/2000

RIPARIAN ASSESSMENT WORKSHEET

Name of Stream: Sullivan Creek Station ID 02-C201
ID Team/Observers: Laidlow / Schneider / Tyler Date: 8/22/0
Length of Reach: 1/2 Mi Other Data below Quintonkian

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 7 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 2 Potential Score: 4

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 6 Potential Score: 6

Comments

1

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

– 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 5 Potential Score: 6

Comments

estion 6, Weeds :

No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 3 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

nments

2

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 8 Potential Score: 8

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 2 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating >_ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating >_ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating >_ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating >_ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating >_ 6

Actual Score: 8 Potential Score: 8

Comments

check sp later

3

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main

rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

STREAM/PROJECT: ________ REACH I.D ________ DATE: ________

			Actual Score	Possible Points	Potential Score
QUESTION 1:	7/8	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	2/4	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	6/6	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	3/3	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	5/6	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	3/3	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	3/3	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	8/8	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	2/4	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:		Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	6/6	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
		Total	0	61	0

	Actual Score	Possible Points	Potential Score
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)	0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)	0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

Actual=45
Potential=45 = 100%

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4

Supplemental Questions to NRCS Riparian Assessment Worksheet

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, and/or aquatic vegetation

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream type would not support a fishery under natural conditions

Actual Score: 6 Potential Score: 6

Comments tadpole scooped up during netting for macroverts

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 4 Potential Score: 6

Comments

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

5

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments Giardia

stion 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

6

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments No irrigation

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 6 Potential Score: 6

Comments

Total Actual 38 Total Potential 40

#12 6/6
13 4/6
14 6/6
15 6/6
16 4/4
17 4/4
18 8/8

RATING $\frac{\text{Total}}{\text{Potential}}$ x 100 #DIV/0!

OVERALL RATING $\frac{\text{(Total NRCS Actual + Total MT Supplement Actual)}}{\text{(Total NRCS Potential + Total MT Supplement Potential)}}$ x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

95%

7

Updated 4/2002

AQUATIC PLANT FIELD SHEET

Date: 8/22/02 Site Visit Code: 02-C201

Waterbody Sullivan Creek Site: below Quintonkian

Personnel: Laidlaw / Schroeder / Tyler / Predmore
Bandera / Kirucek

Purpose: The purpose of completing this form is to estimate the percent of wetted substrates at the sampling site covered by each of the major categories of aquatic plants, to record the relative amount of accumulated growth in each category, and to note the general color and condition of plants in each category. This information will help to describe the health and productivity of the aquatic ecosystem, define nuisance aquatic plant problems, identify potential sources and causes of pollution, and document changes in the plant community over time.

Type of plant growth	Cover (%)	Amount of growth	Color	Condition
Microalgae	25	lite		
Macroalgae	10	lite	green	
Mosses	0			
Macrophytes	0			
Bare substrate	65			
Total	100 %			

Substrates present (please rank):

rock: 1
wood: 3
sediment: 2
other (list):
1)
2)
3)
4)
5)

Explanation and Definitions

Cover: Estimate the percent of wetted substrate area colonized by each of the plant categories listed, and the percent area that is not colonized by any plants (see Bare Substrate, overleaf). Also, rank the types of substrates that are available for colonization by plants (1 = substrate accounting for the most area, etc.).

Amount: Record the relative amount of plant growth in each category as being light, moderate, or heavy. Light growth barely covers the substrate surface and is not immediately evident. Heavy growth extends almost to the water surface or beyond. Moderate growth is intermediate between light growth and heavy growth.

Color: The colors of aquatic plants are clues to their identity and to the health of aquatic ecosystems. Plant colors may span the spectrum of hues in the rainbow (see Microalgae below). Record the predominant color of the plants in each of the categories present.

Condition: Aquatic plants go through seasonal cycles of growth, maturity, and decay. The condition of a plant or group of plants will indicate the stage of this seasonal cycle. Growing plants show new growth and bright colors. Mature plants are larger but have more subdued colors because of age, epiphytes and sediment deposits. Decaying plants display a loss of both pigmentation and physical integrity. Enter growing, mature, or decaying.

Microalgae: Microalgae are microscopic algae appearing as pigmented accumulations attached to or resting upon submerged surfaces. This category commonly includes diatom "slimes" and films of green, blue-green, or euglenoid algae in depositional areas. Colors may range through shades of yellow, red, brown, green, blue and black. Included here are accumulations of "sewage fungus" (tan-gray) below sources of organic pollution, "yellow boy" (yellow-orange) below mine adits, and iron bacteria (orange-brown) in groundwater seeps and springs.

Macroalgae: Macroalgae are macroscopic algae whose individual plants or colonies are visible to the aided eye. Macroalgae may be free-floating, or they may be attached to or resting upon submerged surfaces. Examples of macroalgae include filamentous growth forms (*Cladophora, Spirogyra, Ulothrix*), plant-like algae with leaf-like structures (*Chara, Nitella*), compact round or flattened colonies (*Nostoc, Rivularia*), gelatinous masses (*Chaetophora, Tetraspora*), and short, tubular strands (*Lemanea*). Color is highly variable, as it is with the microalgae.

Moss: Mosses are primitive plants that are intermediate in complexity between algae and higher plants. Mosses are common in cold-water habitats in western Montana. Mosses are typically green in color; the shade of green varies with plant vigor and the amount of sediment accumulation.

Macrophytes: Macrophytes or "higher plants" are distinguished from algae and mosses by their larger size and by the presence of true leaves, roots and flowers. Rooted macrophytes typically colonize areas of sediment deposition. Macrophytes may be free-floating (duckweed), submergent (pondweed), or emergent (cattails, bulrush, water lily).

Bare Substrate: Substrates may be void of plant growth because of toxic or sterile conditions or because of recently scoured or unstable substrates. Rocks in mountain lakes and streams may appear to be barren at first glance, but closer examination often reveals a very thin film of diatoms (microalgae) that feels slippery or slimy to the touch. Similarly, nearshore sediment deposits that have not been disturbed for several days will usually develop a film of microalgae. <u>Examine these substrates closely.</u>

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 8/22/02 Site Visit Code: 02-C201

Waterbody: Sullivan Creek Site:

Personnel: Laidlaw / Schroeder / Tyler

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 10	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 8	9-10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 20	16-20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 15	16-20	11-15	6-10	0-5
Comments:	below confluence with Quintonkean which drains ½ total watershed			

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 14	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10	6-8	3-5	0-2
	Left Side 5	Average: 4		
	Right Side 3	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 7.5		
	Right Side 7	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 7		
	Right Side 6	Comments:		

TOTAL SCORE: 105.5 Score compared to maximum possible: 130

8290

Pebble Counts

SUBSTRATE DEQ/MDM				Sullivan Lower	
			Count	% of Total	Cum. Total
Silt / Clay		< 1	3	2.48%	2.48%
Sand		1 - 2	2	1.65%	4.13%
Very Fine	GRAVELS	2 - 4		0.00%	4.13%
Fine	GRAVELS	4 - 6		0.00%	4.13%
Fine	GRAVELS	6 - 8	1	0.83%	4.96%
Medium	GRAVELS	8 - 12		0.00%	4.96%
Medium	GRAVELS	12 - 16		0.00%	4.96%
Coarse	GRAVELS	16 - 22	8	6.61%	11.57%
Coarse	GRAVELS	22 - 32	4	3.31%	14.88%
Very Coarse	GRAVELS	32 - 45	7	5.79%	20.66%
Very Coarse	GRAVELS	45 - 64	21	17.36%	38.02%
Small	COBBLES	64 - 90	37	30.58%	68.60%
Small	COBBLES	90 - 128	13	10.74%	79.34%
Large	COBBLES	128 - 180	7	5.79%	85.12%
Large	COBBLES	180 - 256	10	8.26%	93.39%
Small	BOULDERS	256 - 362	4	3.31%	96.69%
Small	BOULDERS	362 - 512	1	0.83%	97.52%
Medium	BOULDERS	512 - 1024	3	2.48%	100.00%
Large	BOULDERS	1024 - 2048		0.00%	100.00%
Bedrock	BOULDERS	> 2048		0.00%	100.00%
Total # Samples			121		

Quintonkin Creek Historic Pfankuch Rating Comparison

UPPER BANKS	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**	**Str.segment Date**
	0.025-0.125 23 Aug. 74	3.702-3.703 23 Aug. 74	5.388-5.389 24 Aug. 74	6.368-6.369 24 Aug. 74	6.654-6.655 24 Aug. 74
Landform slope	8	6	6	8	6
Mass wasting	6	10	3	9	10
Debris jam potential	4	6	6	6	4
Vegetative bank protection	3	3	3	3	3
LOWER BANKS					
Channel capacity	1	2	1	1	2
Bank rock content	2	2	2	2	2
Obstructions/flow deflectors/sediment traps	2	4	2	4	2
Cutting	4	12	4	12	4
Deposition	4	8	4	8	8
BOTTOM					
Rock angularity	3	3	2	2	4
Brightness	1	3	3	3	3
Consolidat or particle pack	6	4	2	4	4
Bottom size distribution / percent stable materials	12	8	12	8	8
Scouring and deposition	18	12	12	12	18
Clinging aquatic vegetation	3	2	3	4	2
TOTALS	**77**	**85**	**65**	**86**	**80**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

Quintonkin Creek Historic Pfankuch Rating Comparison

UPPER BANKS	Str.segment Date	Str.segment Date
	5.388-5.389 27 July 1979	6.368-6.369 27 July 1979
Landform slope	6	6
Mass wasting	3	6
Debris jam potential	4	2
Vegetative bank protection	6	6
LOWER BANKS		
Channel capacity	1	1
Bank rock content	2	2
Obstructions/flow deflectors/sediment traps	2	2
Cutting	4	4
Deposition	8	8
BOTTOM		
Rock angularity	2	2
Brightness	1	1
Consolidat or particle pack	2	4
Bottom size distribution / percent stable materials	4	8
Scouring and deposition	6	6
Clinging aquatic vegetation	2	2
TOTALS	**53**	**60**

Reach score of: < 38 = Excellent; 39-76 = Good; 77-114 = Fair; >115 = Poor

78.6 Average for Quintonkin Cr. 1974.
56.5 Average for Quintonkin Cr. 1979.